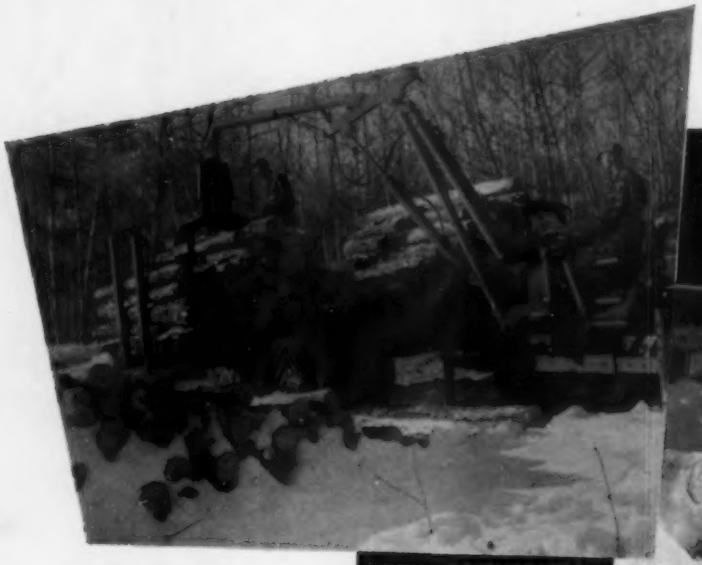
Applied Hydraulics

PNEUMATICS · ELECTRICAL CONTROLS

NOVEMBER 1957



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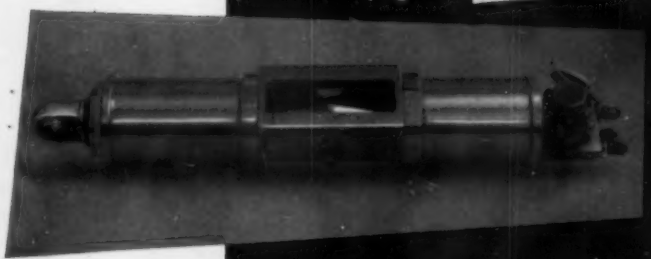

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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

For information about
THE JANUARY 1958 DESIGNERS' GUIDE ISSUE
see page 48

shuts off both sides of line... prevents loss of liquid, gas, or pressure.
Available in brass or steel with female pipe thread connections from ⅛" to 1"

HANSEN

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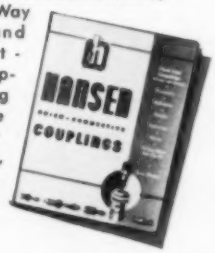
Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.



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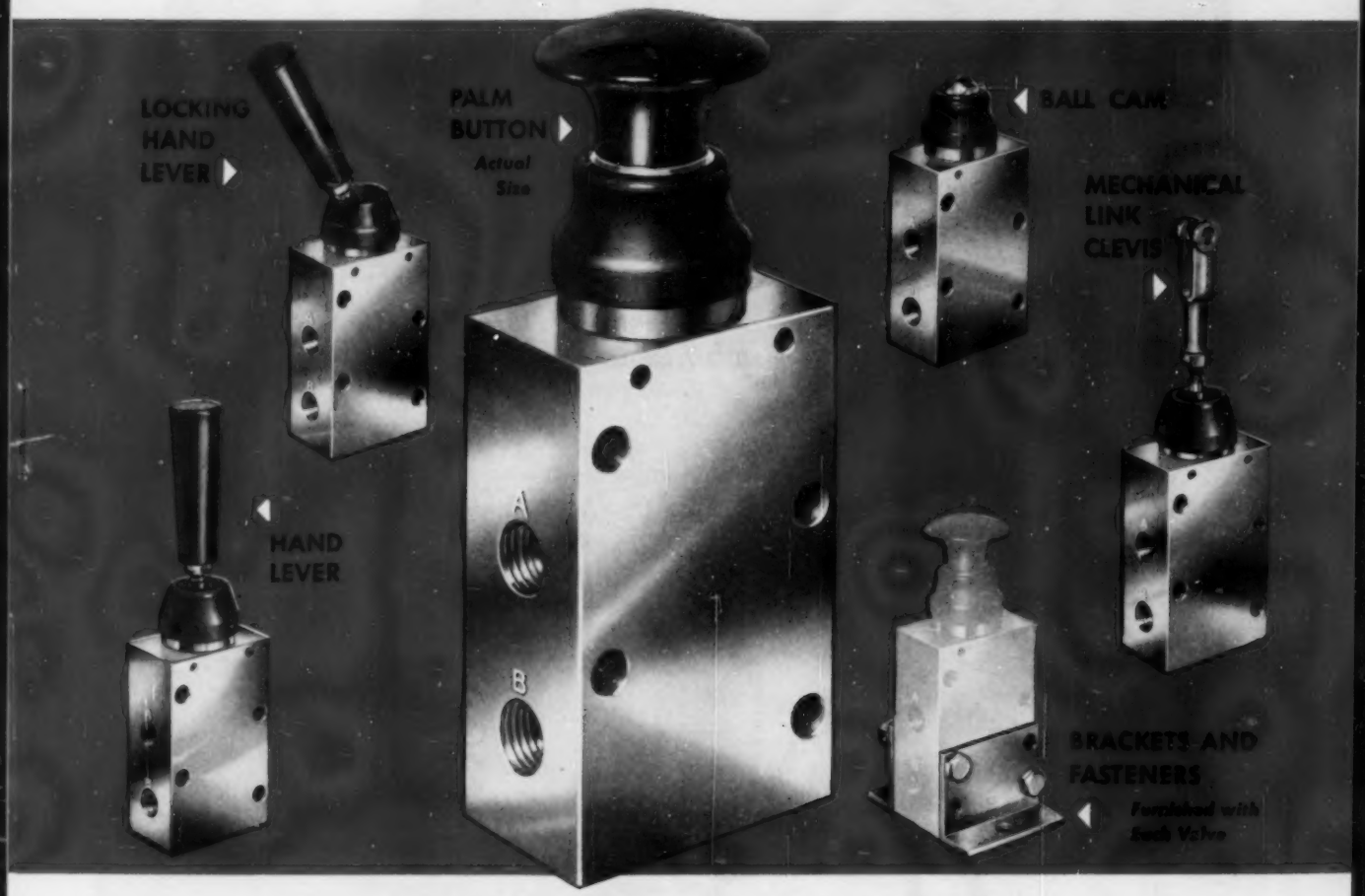


Hanna Flo-Pilot Valves are ¼" two- and three-way Pilot Valves for air operation to 150 psi. They are used for remote control of master valves, directional control of small single acting cylinders and for shut-off. Same valve can be used for two or three-way operation either normally open or normally closed to inlet pressure.

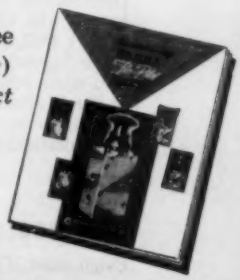
HANNA Flo-Pilot Valves will deliver years of dependable performance at a very low cost because they have built-in money-saving features. Every Hanna Flo-Pilot Valve is equipped with a synthetic boot which seals the valve stem and internal parts from harmful dirt and abrasive, thereby eliminating the most common cause of valve failure.

These protective boots, efficient "O" ring spool packing and nylon sleeves, are built into every Hanna Flo-Pilot Valve to save you money and assure leak-free operation even after millions of cycles.

The five actuating-heads—push button, ball cam, hand lever, locking hand lever and mechanical link clevis—are interchangeable in a matter of seconds. Spools can be changed just as quickly without disturbing the piping.

Corrosion resistant materials are used throughout. Flo-Pilot Valves have a simple, sturdy construction with anodized aluminum body, stainless steel and molded nylon parts. Valves can be conveniently mounted in any position and are furnished with brackets and fasteners. They are easy to operate, positive acting and have full capacity of ¼" orifices.

Ask your Hanna representative (see the yellow pages or Thomas Register) for complete information or *write direct for Catalog 262.*



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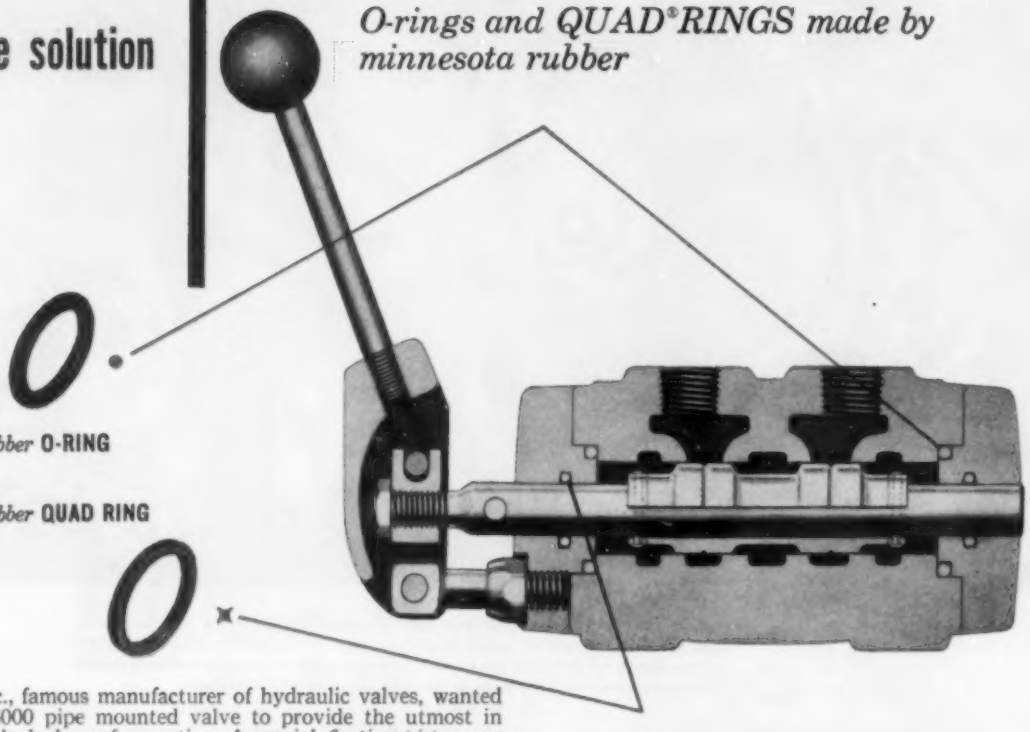
hydraulics problem

how to eliminate gaskets and reduce friction to improve design of a pipe mounted valve

simple solution

O-rings and QUAD® RINGS made by minnesota rubber



minnesota rubber **O-RING**

minnesota rubber **QUAD RING**

RIVETT, Inc., famous manufacturer of hydraulic valves, wanted their Series 5000 pipe mounted valve to provide the utmost in simple, smooth, leakproof operation. A special *floating piston* was incorporated in the design of the valve. This exclusive feature eliminated sticking or binding by keeping the valve stem independent of the bore. To provide a stem seal that would greatly reduce friction, RIVETT chose the Minnesota Rubber QUAD RING. This exclusive seal provided a perfect seal with much less squeeze making operation easier. To obtain design simplicity, more efficient operation and longer life, gaskets were eliminated and replaced by Minnesota Rubber O-Ring cover seals. This combination of advanced design elements and Minnesota Rubber Seals permits multi-million cycle operation at 1500 PSI.

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Note: QUAD RING is a Trade Mark of the Minnesota Rubber & Gasket Co.

Free samples and data. A sample of Minnesota Rubber seals is available together with complete technical data. Simply write . . .

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Applied Hydraulics

Volume 10/Number 11

NOVEMBER 1957 THE MAGAZINE OF FLUID POWER

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Write for Bulletin 303

find out why...

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lubricators are EASIER to fill!

Hannifin's new CROWN Line Lubricators have many advantages. They are precisely adjustable, and the adjustment is concealed, tamperproof. Oil feed is under positive pressure, so you get oil whenever air flows. But users like them best because they are the easiest of all lubricators to fill—you don't even have to shut off the air flow. Bulletin 303 tells why. Complete Crown stocks in most principal industrial areas.

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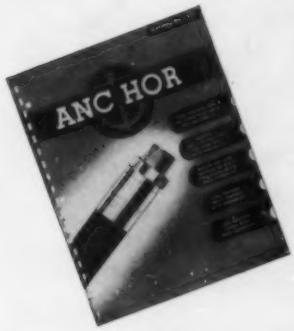
Useful Literature



Any user of hose assemblies for hydraulic, lubricating or air applications, will be interested in Anchor's newest Catalog, No. 101. It is an expanded edition of Catalog No. 100 and not only covers the complete line of Anchor's Pressed On Hose Assemblies, but includes much valuable and informative engineering data on hose assemblies with flow charts, etc., that will prove helpful to both designer and operator of equipment requiring fluid or gas carrying hoses.

Anchor's coupled hose assemblies are available in a very complete range of sizes and with styles to suit in the entire range of services from 100 to 7000 PSI working pressures.

Complete descriptions and specifications are given for Anchor's high pressure assemblies for Two and Three Wire Braid hose with Anchor's exclusive Ductile Sleeve Pressed On Hose Couplings. This patented coupling employs a ductile sleeve in its construction that virtually makes the coupling a part of the steel reinforcing wires of the hose. This type of coupling is available for pressures to 7000 PSI in the ¼" I.D. Three Wire Braid hose size.

Medium and Low Pressure Assemblies are available with sleeveless couplings in both the standard and "MAX-FLO" design, the latter for use where maximum flow capacity is desirable. Hose used for such assemblies is of the One Wire or Two Rayon Braid style.

Spiral Wire Reinforced Non-Collapsible Hose is used for Anchor's Hydraulic Suction Return Line Assemblies.

The new Anchor Catalog No. 101 contains the latest complete specifications on Anchor's expanded line of Pressed On Hose Assemblies. It is made available to all users of hose assemblies by writing to Anchor Coupling Co. Inc., 378 North Fourth Street, Libertyville, Illinois, and asking for Catalog No. 101.

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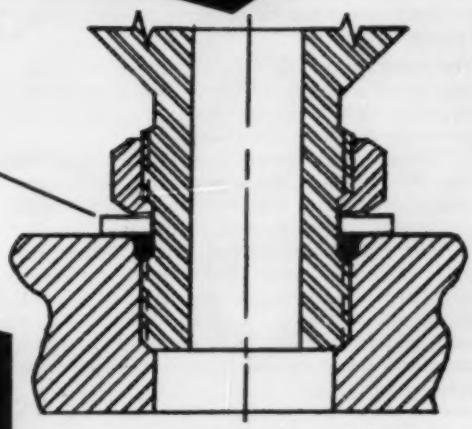
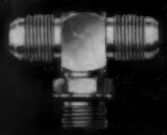
SAE STRAIGHT THREAD "O" RING BOSS FITTINGS

"This NEW Back Up Washer eliminates "O" Ring extrusion"



Anchor Straight Thread "O" Ring 45° Adjustable Elbow.

Anchor Straight Thread "O" Ring 90° Adjustable Elbow.



Anchor Straight Thread "O" Ring Tee.

Anchor Straight Thread "O" Ring Service Tee.

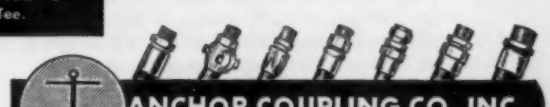
Today, Anchor is offering, not only a more extensive line of SAE Straight Thread "O" Ring Boss Adapters, but a line that is greatly improved as well.

These Anchor SAE Straight Thread "O" Ring Boss Fittings are now equipped with a factory installed, Back Up Washer that eliminates any possibility of "O" Ring extrusion.

In addition to this design improvement, Anchor's already comprehensive line of SAE Boss Fittings is now extended to make available an even greater selection of standard sizes.

This new and broader line of SAE Straight Thread "O" Ring Fittings and Anchor's complete line of standard Adapter Unions and Pipe Fittings are fully described in the new Anchor Catalog No. 203, just off the press. Write for it today!

WRITE FOR NEW ANCHOR CATALOG 203



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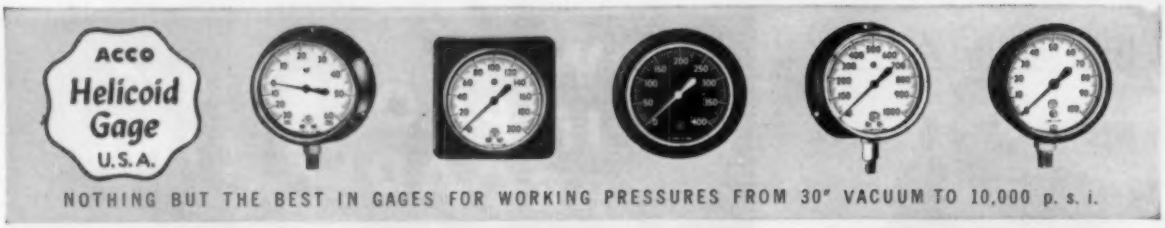

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Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

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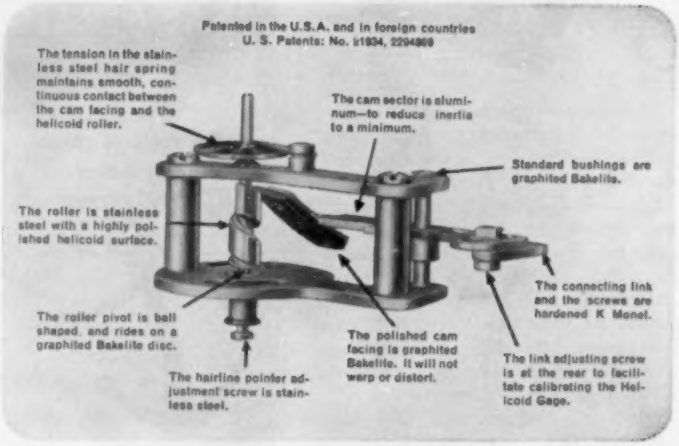
The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294869
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

HELICOID GAGE CARTRIDGE SNUBBER

(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank

EASIEST ADJUSTMENT AND CALIBRATION

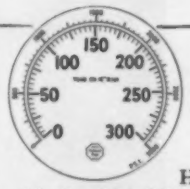
Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

TUBES BUILT FOR MILLIONS OF PRESSURE PULSATIONS

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

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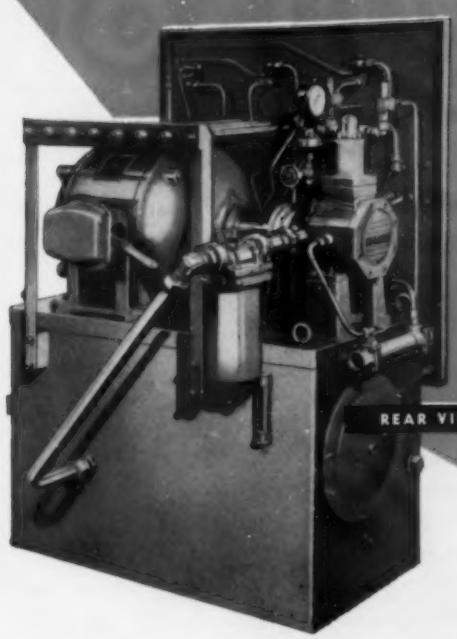
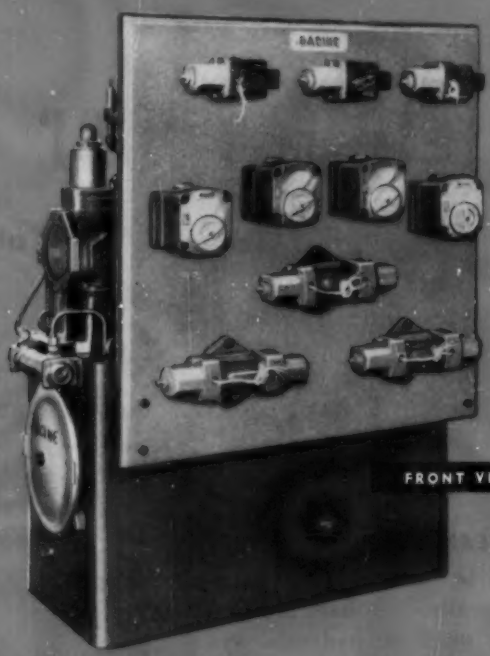
engineer your
hydraulic needs





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HYDRAULIC
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WHY RACINE FACTORY-ENGINEERED, FACTORY-ASSEMBLED *"HYDRAULIC POWER UNITS"* ARE BETTER FOR YOU!

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Fluid Power Lines

about Applied Hydraulics

IT'S REAL COOL, MAN! . . . or it will be soon in many places. Cold weather can have unhappy effects on those hydraulic systems which are unable to spend the winter months in front of a nice warm fire. Fluid gets thick and doesn't want to flow. This means pump starvation, and makes machines sluggish or totally inoperative.

One answer on industrial equipment is use of immersion heaters. Where these cannot be used, an intermittent starting procedure can be successful.

We've assembled useful data on successful methods of hydraulic system operation at low temperatures into the article appearing on page 69. One good thought–offered for what it's worth– is: Take the machine south for the winter. Of course, you go along to take care of it. If some hardheaded soul suggests that this isn't practical, mush eastward 'til you arrive at the article.

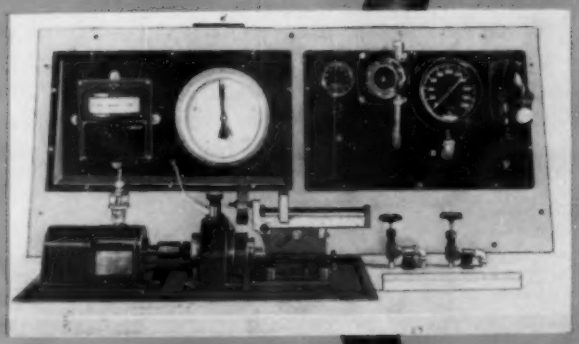
HOW TO INDEX? . . . Fluid motors, rotary actuators, and cylinders are all used in various applications for indexing. At Snyder Tool they frequently use a cylinder working through a rack and pinion, because it's simple and inexpensive. An application of this system is outlined in the article, *Rotary Indexing*.

DEPRESSING CIRCUIT . . . This was a typographical error we saw recently, made with perhaps some logic in labeling a decompression circuit. Especially important where large quantities of fluid are under high pressure, decompression can be tricky where the work has a considerable spring back, as on the bender described on page 120. Timing the decompression period on this machine is a refinement over the original design where the operator observed pressure on a gage and reversed the 4-way when pressure had dropped sufficiently.

COMPRESSED AIR POINTERS . . . Maintenance and layout information on compressed air installations is given on page 103. Moisture, pressure drop, and overloading are the three big dangers. Knowing how to lubricate, select piping, install the compressor, and regulate air pressure are some of the answers to successful operation.

SUPER HIGH TEMPERATURE . . . Aircraft temperature requirements keep climbing higher and higher. Manufacturers of fluids and packings are shooting for operation at 400-700 F. However, actuators operate at temperatures to 1000 F and some cooling must be used. Oil coolers are out because of the low fluid flow. George Keller's article in this month's aircraft section shows actuator designs for direct cooling, and a method for designing cooling jacket baffling.

Low Cost Rotary Seals



Precision test stand especially developed to test efficiency of "O" rings as low cost rotating shaft seals.

Precision "O" Rings from Compound 158-80 provide the answer to a problem for a manufacturer of Oil-Hydraulic Pumps.

1. Eliminated costly hand lapping
2. Reduced friction—increased life
3. Sealed 2000 P.S.I.

Compound 158-80, with built in lubrication, is especially suitable for those jobs where friction is a problem. They are compression molded, rigidly inspected —the finest made!

Have a sealing problem? You'll find the answer at Precision! There's a Precision engineer ready to help you in "O" Ring specification and product design.

Get your free copy of our Engineering Data Sheet on Compound 158-80.

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Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

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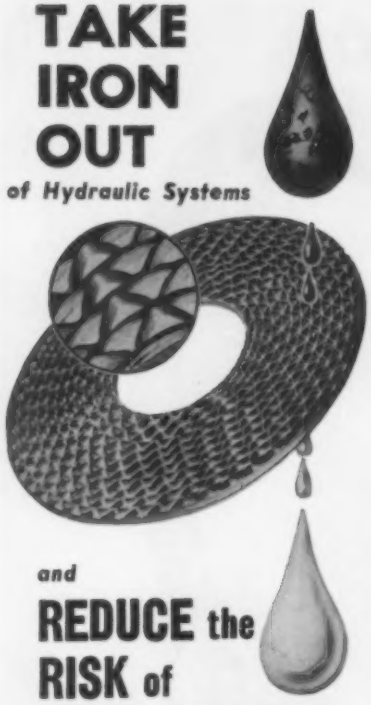
TAKE IRON OUT

of Hydraulic Systems



and

REDUCE the RISK of BREAKDOWNS

with

FERROFILTER

Permanent Magnet Separators

A stack of soft steel grids (one grid shown above) is magnetized by powerful permanent magnets. The strong magnetic pull, adjacent to hundreds or thousands of feet of grid edges, catch and hold extremely fine ferrous particles which, otherwise, would wear or score precision fitted parts . . . make valves stick or clog small openings.

Write today for BULLETIN PM-65

S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.
P. O. Box 1138 Trenton 6, N. J.

Fluid Power Lines

continued

MODIFYING COMPONENTS . . . When there's no component available to do the job, the problem is whether to work out an original design or modify an existing component to get the required characteristics. In the equipment described on page 123, a relief valve was modified to function in an unusual application where its setting is constantly adjusted according to the force exerted on a spring under test.

HAND-ME-DOWNS . . . Electrohydraulic servo valves originally developed for aircraft are finding more and more applications in industry. Numerically and cam-controlled machines translate their input information into a signal to the valve which controls a hydraulic actuator to position a machine slide accordingly. An excellent example of this application is the Farnham spar miller described on page 87.

VALVE PRINCIPLES . . . Know how to draw the spool for a tandem, 4-way valve? Can you explain *overlap* and its characteristics? A basic article on spool valves appears on page 106 to review the principles of these directional controls.

LIKE TO SAVE A BUCK? . . . Some fellows out in Rockford, Ill. have discovered a way to really reduce the size of the pump you have to buy if your application involves a cylinder, and necessary force decreases as the speed requirement increases. You can read all about it on page 73.

STRAIGHT TALK FROM ENGINEERS . . . During a symposium conducted by AH's editorial staff, engineers at National Acme Company, Cleveland, gave their viewpoints on the use of hydraulics and pneumatics on the machine tools they produce. Using question-and-answer form, the article starts on page 146.

MORE ON FIRE-RESISTANT FLUIDS . . . Sixth and concluding article of this series of basic articles on the different fire-resistant hydraulic fluids currently available, appears on page 116. Previous articles were: April—Emulsion Fluids; June—Aqueous Base Types; August—Phosphate Ester Base Types; September—Pure Phosphate Ester; and October—Change-Over Practice.

Circle 49 on Reader Service Card

Circle 53 →

WARNING!

Cutaway drawing of typical hydraulic cylinder. Orange shading indicates packing applications.

WHEN YOU CHANGE TO A FIRE-RESISTANT HYDRAULIC FLUID, CHANGE PACKINGS, TOO!

Here's why: Many fire-resistant fluids are highly destructive to the common rubbers used for packing mineral base oils.

The Garlock "ORANGE LINE" of packings has been developed specifically, and ONLY, for packing *phosphate ester* type fire-resistant fluids in dynamic applications.

The ORANGE stripe across the packings quickly identifies them as suitable for use against fire-resistant fluids. Butyl Rubber is the base material used in these packings and is *not* compatible with mineral base oils. Therefore the "ORANGE LINE" packings should only be used with the phosphate ester type fire-resistant hydraulic fluids.

*Registered Trademark

The Garlock "ORANGE LINE" for fire-resistant hydraulic fluids is available in CHEVRON* Packings, KLOZURE* Oil Seals, Split KLOZURES, U cups, flanges, O-Rings, and other forms of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals to meet *all* your needs. It's the only complete line . . . it's another reason why you get unbiased recommendations from your Garlock representative. Call him today or write for further information on recommended packings for use against fire-resistant hydraulic fluids.

Garlock CHEVRON Packing set. Orange stripe quickly identifies packing as suitable for use against fire-resistant fluids.

THE GARLOCK PACKING COMPANY, Palmyra, New York

For prompt service, contact one of our 30 sales offices and warehouses throughout the U. S. and Canada

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

BACKED BY A QUARTER OF A CENTURY OF LOCKHEED HIGH-PRECISION HYDRAULICS

Control valve

FOR FORK-LIFT TRUCK

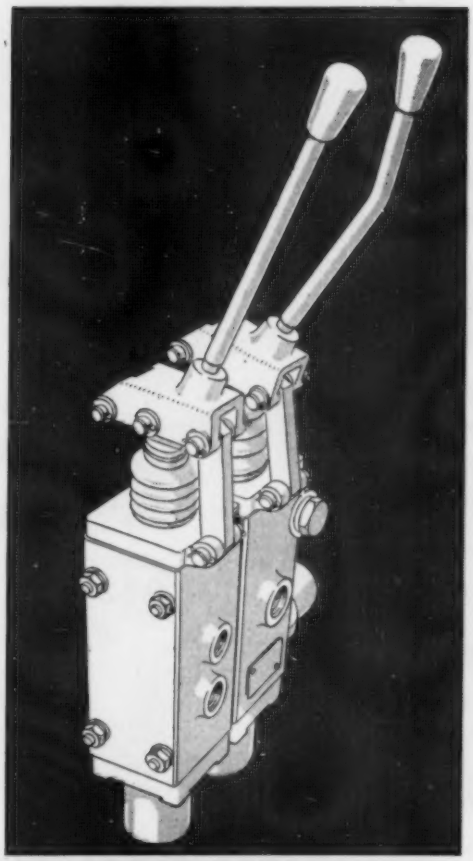
This efficient dual control valve consists of two standard Lockheed units, one controlling the tilt cylinder and one the lift cylinder on a well-known make of fork-lift truck. It can, of course, be usefully employed in many other applications. The valve for the tilt cylinder, which is double-acting, is of the 4-way type. The lift cylinder is of the single-acting type and the 3-way control valve is used. The roller on the extension is designed to operate the pump motor switch.

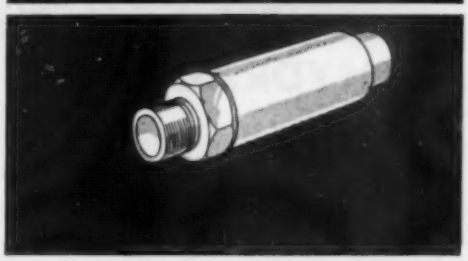
The unit can be supplied in a number of variations either with both 4-way valves or both 3-way valves, or with further valves to meet requirements.

Used in conjunction with this valve is a flow control valve, illustrated on the side. This is a simple but important unit which maintains, at an approximately constant rate, the lowering of the fork of the truck, regardless of the load which it may be carrying.

This is but one of many highly specialized Lockheed hydraulic units, proved in a wide range of applications.

For further details please write for pamphlets, and kindly mention this journal.





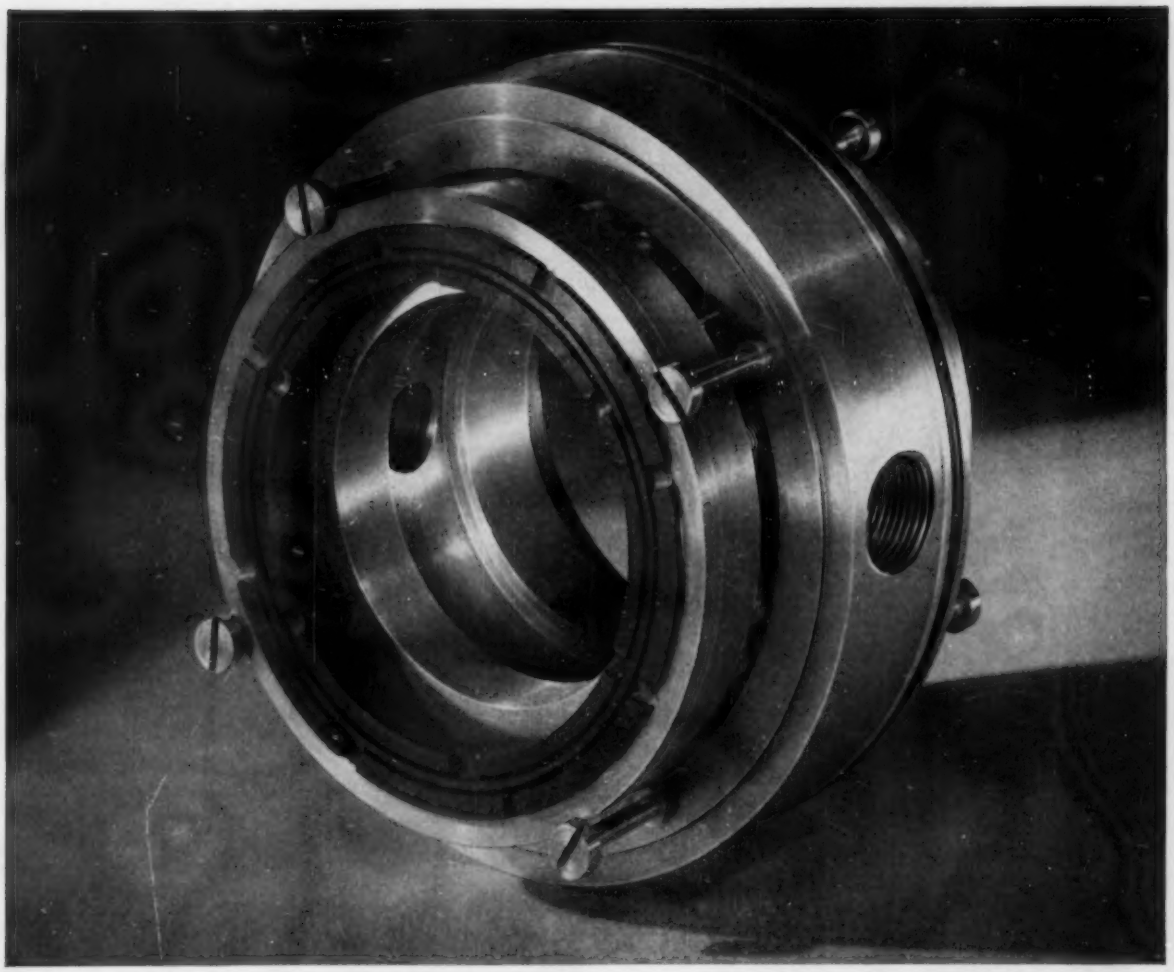
AUTOMOTIVE PRODUCTS COMPANY LTD.,
Shaw Road, Speke, Liverpool, England. Telephone: Hunts Cross 2121

Lockheed

REGD TRADE MARK

INDUSTRIAL HYDRAULICS

COMPLETE INSTALLATIONS BRITISH MADE OR INDIVIDUAL UNITS



Koppers Face Type Seal Provides Up to 20,000 Hours of Service!

Up to 30,000 Hours in Laboratory Tests Using Clean Gas!

Koppers engineering has created an unmatched sealing surface that gives Koppers Face Type Seals a much longer-than-ordinary service life.

The exclusive design of the sealing surface keeps pressure distribution and hydraulic balance unchanged during operation . . . permits a light face loading which lowers interface temperatures. Hydraulic balance allows sealing of gases and liquids through a wide range of rubbing speeds. Rugged construction adds to Koppers long service life. Rotating collars can be of hardenable stainless steels, cutlery and die steels, Stellites, or of a hard chromium or carbide face. Ring is of carefully selected grades of carbon.

If you have a sealing or piston ring problem, Koppers entire research, production and engineering facilities are at your disposal. For more details, write to the KOPPERS COMPANY, INC., 1511 Hamburg St., Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS

MECHANICAL SHAFT SEALS

← Circle 18

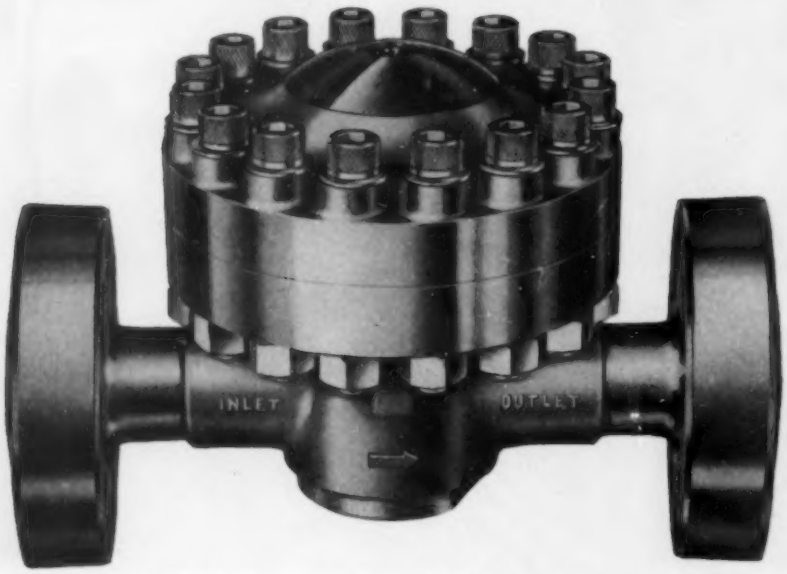
Circle 81 on Reader Service Card

new design achievement by APCO

...THE SERVO-DOME PRESSURE REGULATOR

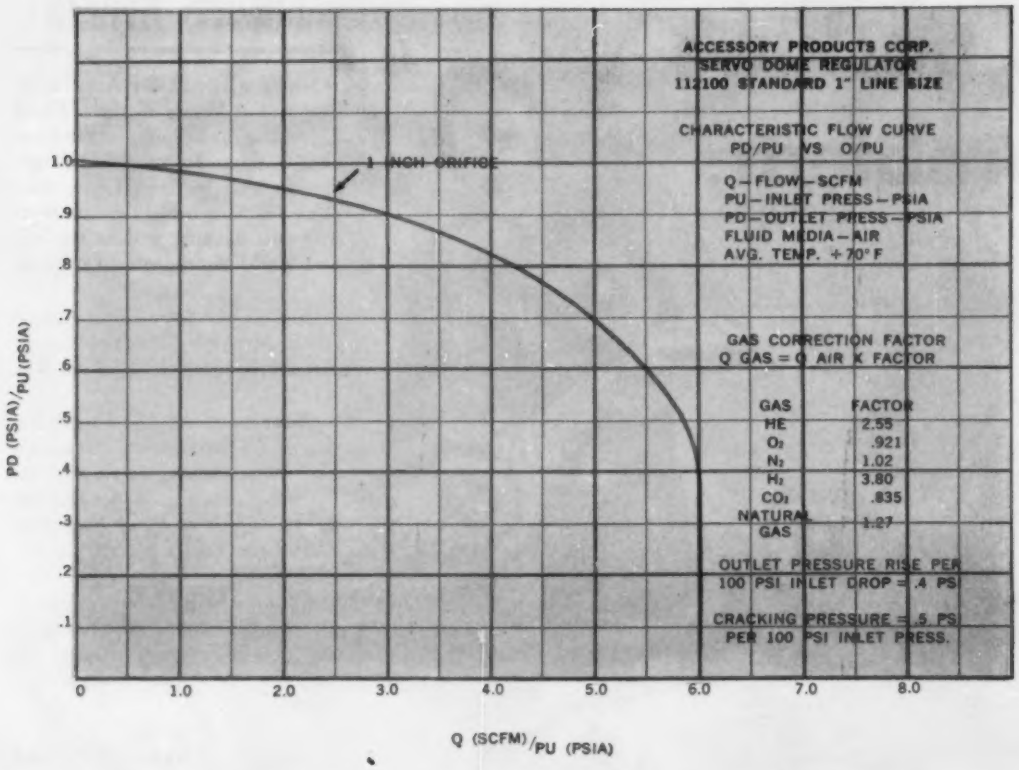
in stainless steel, aluminum, alloy steel, or bronze

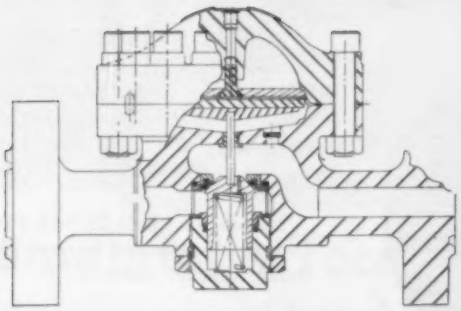
Reduction of initial air, gas or liquid pressures to optimum delivered pressure, and/or flow and continuous control thereafter...with extreme accuracy and operational versatility ... is now possible with APCO's new Servo-Dome Pressure Regulator.

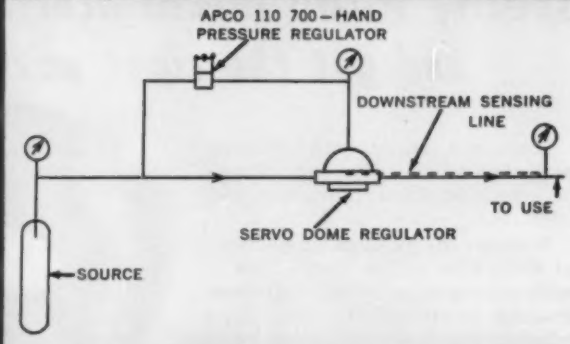


Check these outstanding performance features:

- ***Line sizes and orifice sizes from ¼" to 3", e.g. 3" line—3" orifice!***
- ***Inlet pressures from 0 to 6000 psi!***
- Outlet pressures from 0 to 5500 psi!
- Positive shut-off—zero leakage!
- Balanced poppet feature provides:
  - Longevity of seat life from low seat load!
  - Low diaphragm ΔP at any given pressure conditions!
  - Cracking pressures minimized!
  - Dampened downstream surge due to inlet decay!
  - Equivalent orifices to line sizes!
- Precision control accuracy and instantaneous response!
- Direct acting—eliminates pilot controls!
- Smooth, vibration-free movement!
- Wide range of fluid media: air, gases and liquids!
- Extremely high flows, i.e., 1" unit at 6000 inlet, 1000 outlet provides a flow of 0 to 36,000 scfm!
- Temperature range: −65°F to +250°F!
- End connection available in flanged, pipe, tube or custom!
- Downstream control is internal or downstream sensing!
- Dome loading is external or self-contained!
- Burst pressure four times rated pressure!
- Buna N and nylon diaphragm is optional!
- Extremely maintenance-free!
- Internal parts easily accessible while installed—allowing simple maintenance!
- ***Available for 30-45 day delivery in any material or line size!***





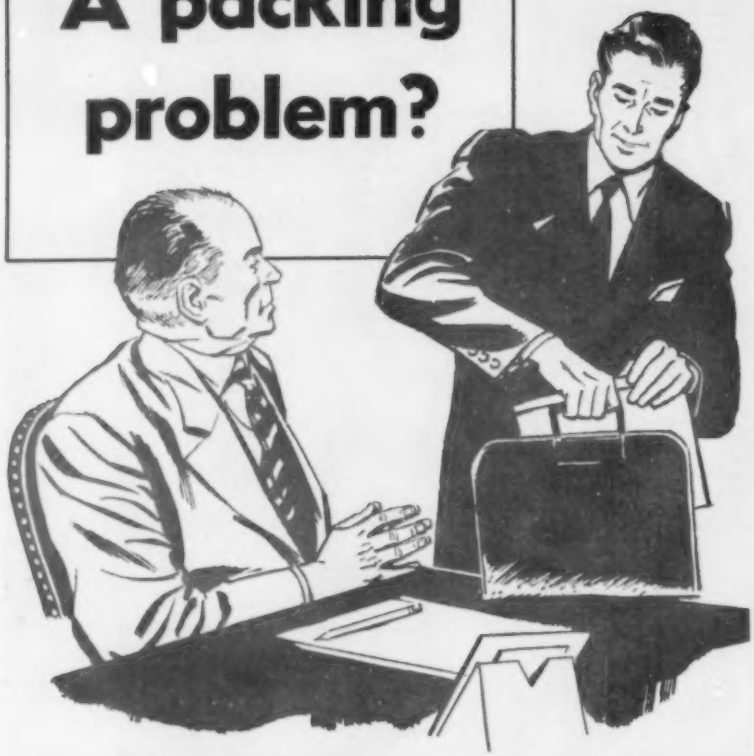


When pressure control problems confront your engineering skill, be sure of dependable performance and maximum control accuracy by specifying APCO's new Servo-Dome Pressure Regulator. We solicit your inquiry.

ACCESSORY PRODUCTS CORPORATION

DEPT. AK, 616 West Whittier Boulevard, Whittier, California

A packing problem?



specify PAGE Mechanical Packings and get the right answer

If you find yourself with a packing problem, why not call in one of Page's packing experts and let him help you.

Whether the job calls for packings of Oak, Chrome or Retan, treated with any one of many impregnations, coatings or special finishes . . . or whether synthetics will work better . . . you know you can count on Page for quality and service.

Page offers you a complete line of U's, V's, Flanges, Cups, and O-rings, backed up by nearly a century of experience and complete facilities for production of one or thousands.

- for temperatures to 225° F.
- long life
- low cost
- fast delivery
- engineering assistance

Call or write us about your packing problems, for a quote, or for your copy of the Page Packing Manual.

PAGE BELTING CO. trademark

PAGE BELTING COMPANY
established 1868

Concord — New Hampshire

Page Packings — engineered to do a better job

Future Events

November 2-8: American Society For Metals. National Metal Exposition and Congress, and annual meeting. International Ampitheatre and Palmer House, Chicago, Ill. Also held in conjunction with this meeting will be the second World Metallurgical Congress.

November 4-6: Ninth Annual AIEE Machine Tool Conference, Hotel Schroeder, Milwaukee, Wis.

November 13-15: Eighth National Conference on Standards and 39th Annual Meeting of the American Standards Association. St. Francis Hotel, San Francisco, California.

December 1-6: Annual meeting of American Society of Mechanical Engineers. Statler and Sheraton McAlpin Hotels, New York.

January 13-17, 1958: SAE Annual Meeting and Engineering Display, The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

January 27-30: Plant Maintenance & Engineering Show, International Amphitheatre, Chicago. For further information write Clapp & Poliak, 341 Madison Ave., New York 17.

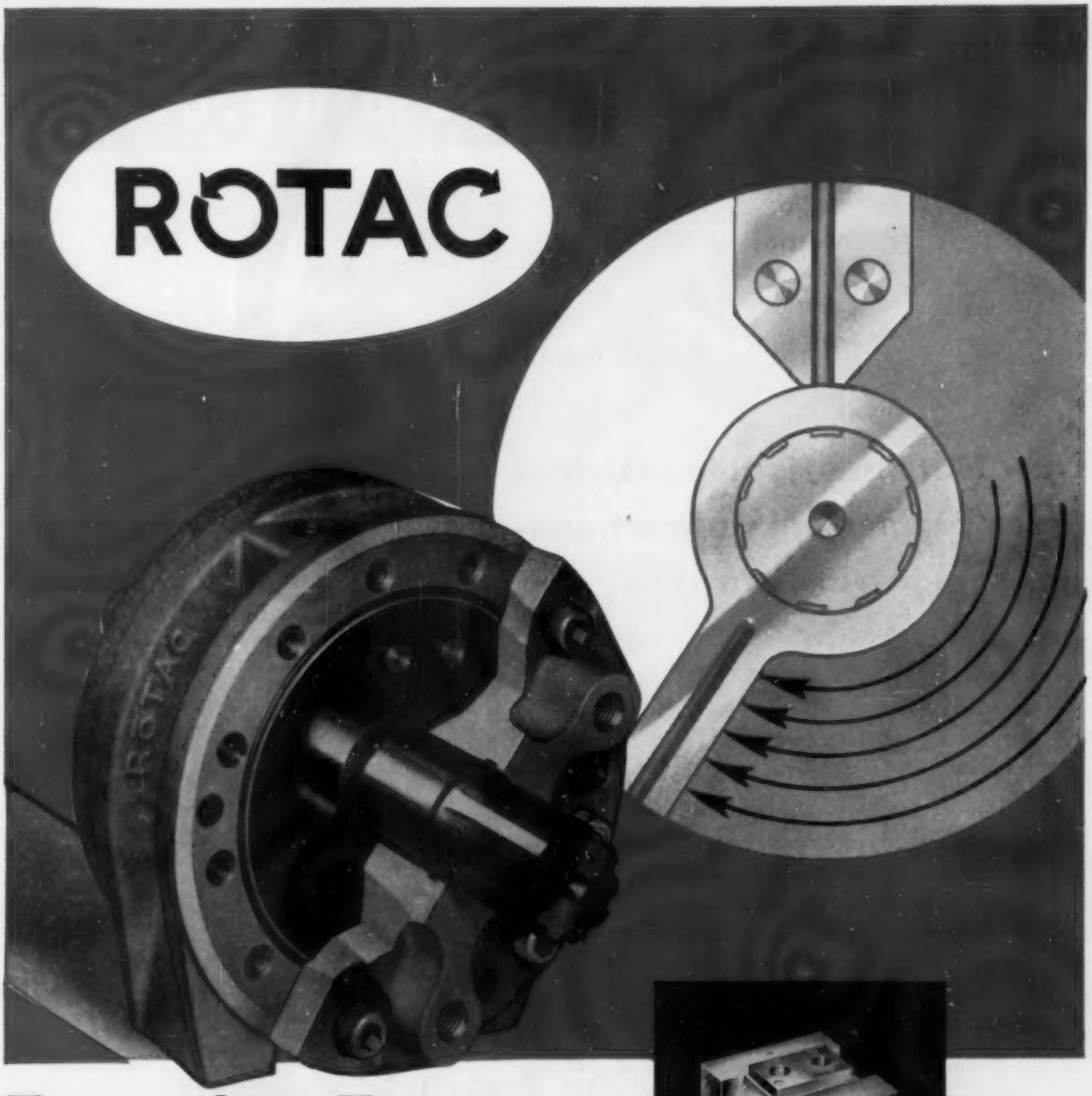
March 31-April 2: SAE Production Meeting and Forum, The Drake, Chicago, Illinois.

April 8-11: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N.Y.

April 14-17: Design Engineering Show, International Amphitheatre, Chicago. Write Clapp & Poliak, 341 Madison Ave., New York 17, for further details.

May 1-8: ASTE Tool Show, Convention Center, Philadelphia, Pa. For complete information write ASTE, 10700 Puritan Ave., Detroit 38, Mich. ▼▼▼

Circle 102 on Reader Service Card



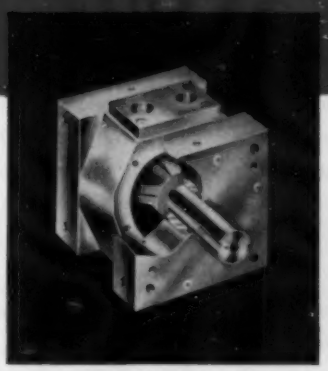
Tremendous Torque in Small Space

If you are at all concerned with an operation involving power transmission, you owe it to yourself to investigate this new name in reciprocating torque actuators: Rōtac.

The name, Rōtac, may be unfamiliar to you because of its very newness—but the name (and reputation) of Ex-Cell-O should excite your interest. Even now, Rōtac reciprocating torque actuators are performing such operations as clamping, indexing, lifting, revolving, lowering, extending, retracting, closing, opening, oscillating and turning, on a wide variety of machinery.

FREE LITERATURE

If you move *anything*, then you'll want detailed information on Rōtac. Learn how this rotary power is used throughout industry in thousands of applications. Complete with photos, schematics, engineering data, etc. *57-59*



XLO

EX-CELL-O FOR PRECISION

GREENVILLE PLANT, GREENVILLE, OHIO

EX-CELL-O CORPORATION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

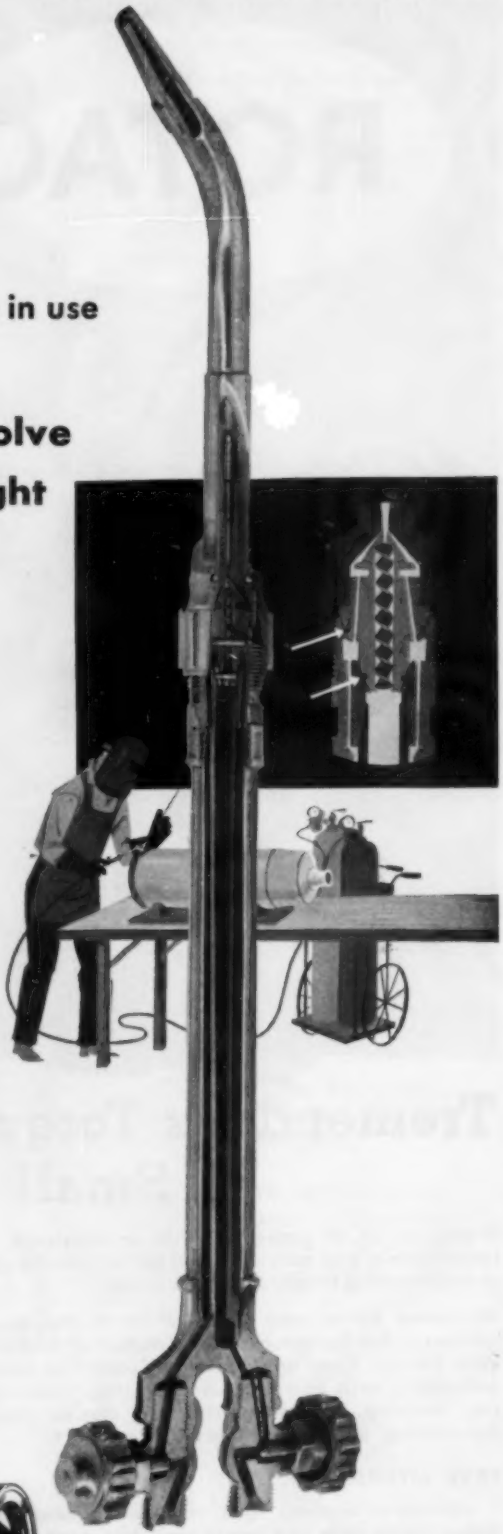
Ozone deterioration

Continuing stress

Gas leakage

Rough handling in use

New National Hypalon O-rings solve these problems; insure a hand-tight gas seal in Victor Torches



As static seals, commercial Buna N O-rings performed satisfactorily in Victor welding torches — *when the rings were new.*

However, ordinary O-rings age fast in welding torches. They receive rough treatment when welders change nozzles; nozzles are often dropped on the ground to lie there until needed again. Severe ozone deterioration is experienced. Continuing stress, although mild, impairs O-ring elasticity. Rings on welding nozzles are sometimes subjected to long shelf life.

National Seal engineers developed a new O-ring compound, National Hypalon L-11, which not only withstands rough handling, ozone deterioration and stress but exhibits many times the shelf life of Buna N compounds previously used. Today, National Hypalon is standard at Victor.

Special compounding to meet unusual conditions is a basic part of National's complete O-ring engineering service — service available from National Field Engineers in major cities nationwide.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
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Plants: Van Wert, Ohio, Redwood City and Downey, California

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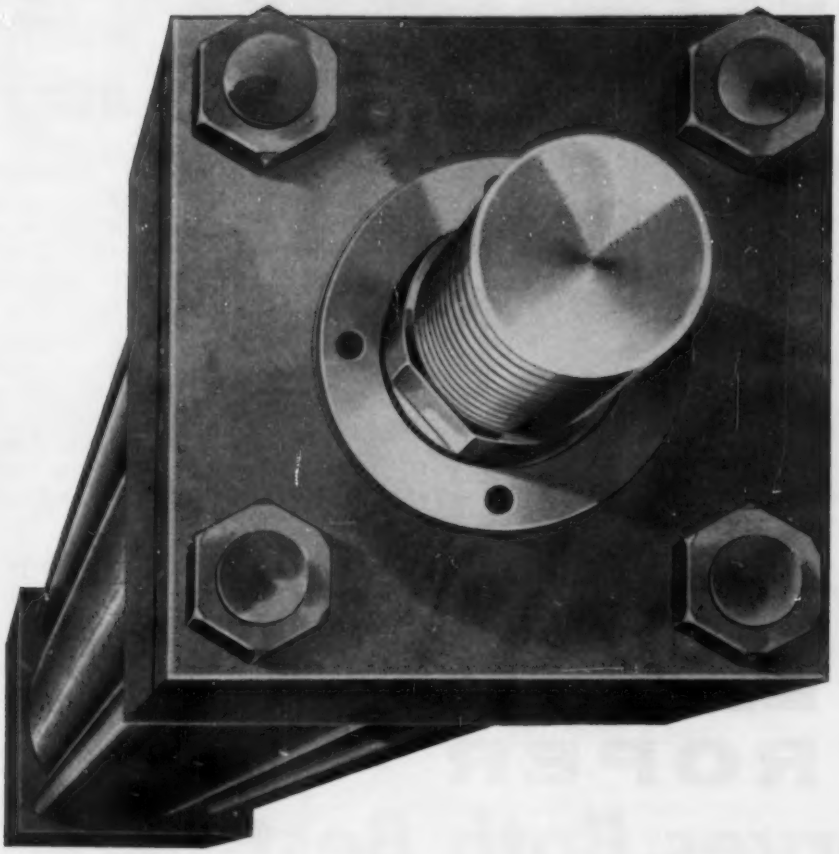
AT YOUR REQUEST...



ANKER-HOLTH

Hydraulic Cylinders now available in Square Head design

Positive Trouble-free Performance

Anker-Holth Division, for 18 years designers and manufacturers of quality air and hydraulic power cylinders, now offers a standard line of all steel, high pressure square head tie rod cylinders. Important new operating features and design achievements assure positive controlled power for a wide range of industrial applications.

Standardized Mountings for Interchangeability

Conservatively rated at 2000 P.S.I. working pressure and 3000 P.S.I. non-shock pressure every cylinder is proof tested at 4500 P.S.I. All mountings are available, standard bores from 1½ to 8 inches. Standardized mountings provide complete interchangeability with most makes of square head cylinders. The Anker-Holth "□" line meets all J.I.C. specifications.

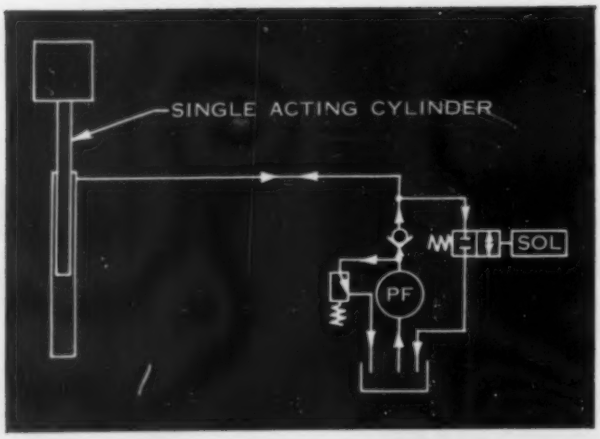
For more information contact your local Anker-Holth representative or Anker-Holth Division, Port Huron, Michigan. YUkon 5-7181

ANKER-HOLTH DIVISION

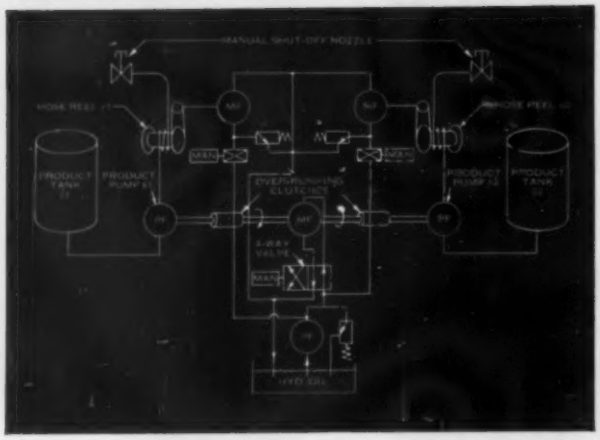
THE WELLMAN ENGINEERING COMPANY

2723 CONNOR STREET, PORT HURON, MICH., U. S. A.

SIMPLE CIRCUIT



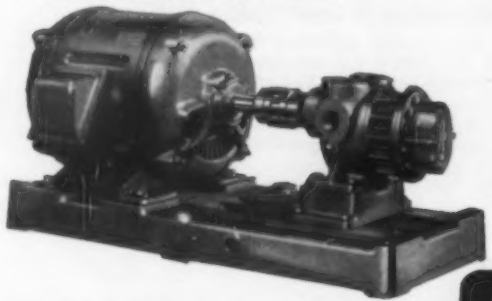
COMPLEX CIRCUIT



ROPER

Serves Both Best

The key to any hydraulic system is the pump. It must have the proper characteristics in relation to the other equipment in the circuit — whether simple or complex. It must also be *dependable* and have the *stamina* to provide long and trouble-free service. Roper Rotary Pumps *have* the attributes that are so necessary to effect optimum performance, and you can count on them for successful control of circuits involving either tons or pounds. On your next hydraulic problem, investigate Roper Rotary Pumps. Find out how they can be the key to a dependable hydraulic system.



PUMPS TO 1000 P.S.I.
•
HYDRAULIC PUMP-MOTORS
High Torque Low Speed
Up to 11.5 H.P. output

SEND FOR CATALOG AND BULLETIN 22

GEO. D. ROPER CORPORATION
711 Blackhawk Park Avenue
Rockford, Illinois

ROPER
Rotary Pumps

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

JIC Standards

We would appreciate information on where to obtain JIC Standards on both hydraulic and electronic equipment.

J. STEIN
Design Engineer
West Coast Research Co.
Los Angeles, Calif.

You can obtain JIC Standards for hydraulic, pneumatic, and electrical equipment by writing to J. I. C., Box 182, Northend Station, Detroit 2, Mich.

Hydraulics Training

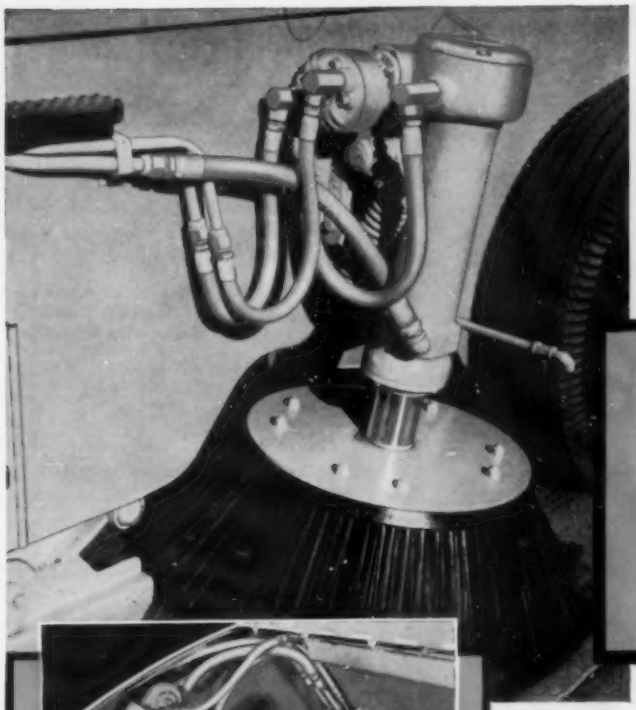
We are particularly interested in the article "Hydraulics Training" in your August issue. We would like to obtain a copy of the outline of the hydraulics course developed by Republic Steel Corporation. Please forward our letter. We have been offering courses in hydraulics to members of local industry through our Adult Evening Education Program, and are very much interested in what other communities are doing.

JAMES E. JACOBS
Director
Vocational & Adult Education
Grand Haven Public Schools
Grand Haven, Mich.

Your letter was forwarded to R. D. Reeve, author of the article, and he has answered you as follows:

The Human Engineering Institute is developing and directing training programs for employees of Republic Steel Corporation. The program described in APPLIED HYDRAULICS is designed for pipefitters and other maintenance men who are called upon to install and maintain hydraulic equipment. An adaptation of that same program is also being given to first-line supervisors in both

Continued on page 22



THREE HYDRAULIC CONTROLS INCREASE BROOM LIFE:

1. Constant sweeping pressure maintained hydraulically with "floating" pressure, which compensates for any street irregularities.
2. Relief valve protects mechanism from curb damage.
3. Snubbing action eliminates bounce and undue wear to the broom.

HYDRAULICS IMPROVE SWEEPER PERFORMANCE

Two hydraulic circuits are used at maximum pressure of 1250 psi., supplied by direct driven pumps independent of vehicle drive.

Conveyor belt is driven hydraulically. Main broom floats under hydraulic pressure, with one lever controlling broom rotation, activating automatic belt training and conveyor belt rotation. Double acting hydraulic cylinders also open and close hopper.

Eastman—Elgin Engineering Staff Cooperate to Improve Efficiency and Service . . . Cut Manufacturing Costs

When Elgin Sweepers were converted to hydraulics, Elgin engineers enlisted the cooperation of Eastman engineers in the pilot application of Eastman Hydraulic Hose Assemblies.

The result of Elgin's conversion to hydraulics was more than an improvement in operating performance and efficiency—it resulted in space-saving economies which permitted dramatic improvements in streamlined design—as well as reduced manufacturing and maintenance costs.

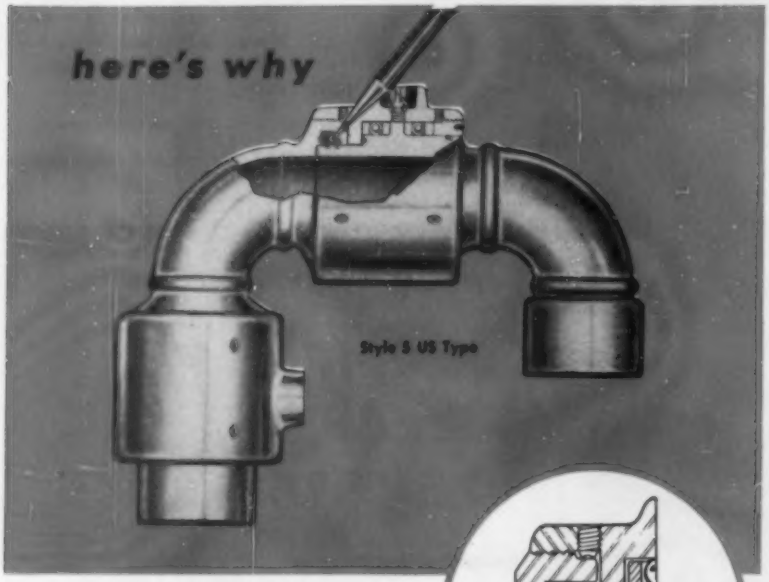
Again, as in many instances in the past . . . Elgin, who pioneered the first successfully marketed sweeper in 1912 . . . turned to Eastman—who pioneered in the very first applications of Hydraulic Hose Assemblies. LEACH PACKMASTER, an associate Elgin product, is also an original Eastman user.

We invite you to write if you have a hydraulic conversion problem. We urge you to call upon our more than 40 years of experience—unequalled in the industry. Take advantage of our many original designs and advanced construction features. Enjoy the sales prestige of Eastman Hydraulic Hose Assemblies—*Standard of the Industry!*

Eastman
first in the field

MANUFACTURING COMPANY
DEPT. AH-11, MANITOWOC, WIS.

CONTINENTAL-EMSCO SWIVEL JOINTS LAST LONGER



GROOVED PACKING
Type US for high temperature or Corrosive Service.

UNIQUE DESIGN PERMITS EASY MAINTENANCE WHILE IN OPERATION

Three basic advantages of the Continental-Emsco Ball Bearing Swivel Joint are:

1. FREE TURNING
2. EFFICIENT PACK-OFF
3. LONG LASTING

A Continental-Emsco Swivel Joint is practically unexpendable for the reason that, after long service, both the packing and the ball races are easily adjustable and replaceable. This means no discarded joints—no costly return to the factory for repairs.

Continental-Emsco "free turning" Ball Bearing Swivel Joints are manufactured for almost every type of service, from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°F. Complete information, prices and delivery upon request.

Deformable packing extruded into annular grooves assures a positive seal. This Continental-Emsco patented method minimizes the effect on torque. Any packing material such as asbestos, Blue African Asbestos, or Teflon may be used in the US Type joint.

Joints using a lip type packing are available as Type HS or HP, depending on pressure involved.

LIP TYPE PACKING

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL-EMSCO COMPANY
A Division of The Youngstown Sheet and Tube Company
P.O. Box 2098, Terminal Annex, LOS ANGELES 58, CALIF.
HOUSTON, TEXAS DALLAS, TEXAS CHICAGO, ILL.
Export Representative, R. J. Sicho & Associates, Inc.
10 Columbus Circle, New York 19, N.Y.

LETTERS to the editor

operation and maintenance. A topical outline of the course as we now conduct it has been sent to you.

J. C. NICHOLS
Assistant Director
Human Engineering Institute
Cleveland, Ohio

Fluid Power Circuits

Please send us ten copies of your brochure "Fluid Power Circuits". This little book has proved very helpful to our salesmen.

ROBERT D. MILLAN
Gene Howard Co.
Detroit, Mich.

Ten copies of "Air & Oil Circuits Guide" have been sent. This is a revision of the original booklet which you have. Copies are available at 50 cents each. ▼▼▼

Protective Covers

We would like to know who makes bellows type protective covers for hydraulic rams and cylinder rods. Specially made covers would be satisfactory if stock standards are not available.

W. E. MICKLETHWAITE,
Toronto, Canada

List of manufacturers of this item has been sent. ▼▼▼

Hydraulic Fuse

We receive your publication, APPLIED HYDRAULICS, which we find very helpful in our use of hydraulic power for machine operation.

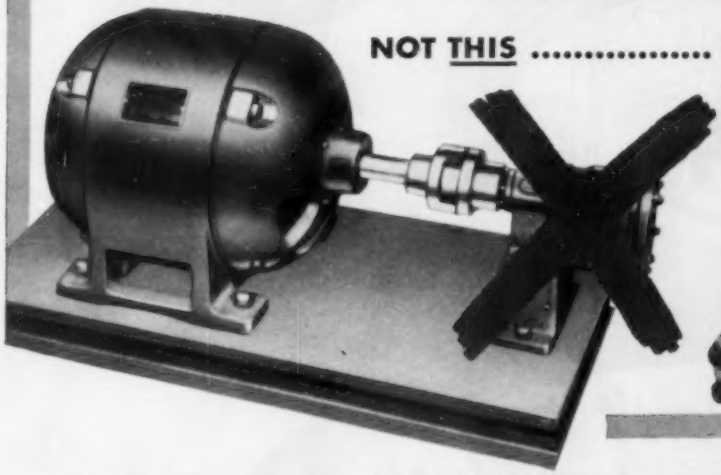
We are searching for a unique type of 3000-psi valve which we can connect into a ⅛ feedline. Its function would be to automatically cut off fluid flow in event of sudden rupture or break in the feed line between the work cylinder and this safety valve.

MERTON B. BRIGGS,
Molded Insulation Co.,
Philadelphia, Pa.

Such devices have been developed and used, primarily in the aircraft industry. List of suppliers has been sent to you. ▼▼▼

NOW AVAILABLE!

New TUTHILL Positive Displacement Pump-and-Driving-Motor Units Require Less Space ...Have No Couplings, Adapters or Base



NOT THIS ..... BUT THIS TUTHILL PROMPTLY-DELIVERED SPACE-SAVING UNIT

• Now there are *two* means by which the problems of space, weight, time and cost can be solved in the application of hydraulic, oil burning and lubricating pumps and motors to industrial equipment.

First, the use of compact, custom-built TUTHILL "POWERMITE" pump-and-driving-motor units for original equipment manufacturers having QUANTITY requirements.

Second, the use of compact, standard, promptly-available TUTHILL pump and driving motor units *for individual applications which do not warrant custom design.*

PUMP MOUNTED ON THE MOTOR

Both provide—with no coupling, adapter, or base:

1. **Important savings in space.**
2. **Reduced weight for less shipping and handling costs.**
3. **Fewer components, thus less expense.**
4. **Less assembly time.**

A typical standard TUTHILL pump-and-driving-motor unit is shown above. Note that *the pump is mounted on the motor*...eliminating the need for coupling, adapter and base...and time normally required for their assembly. In comparison with a regular assembly, the new driving unit saves a minimum of 6 inches in space and weighs several pounds less. The TUTHILL rotary positive displacement pumps used in these driving units range in flow capacity from 20-300 GPH and in pressures up to 1500 PSI. The combinations include ¼ HP motors and larger.

...WHICH REDUCES COST AND TIME ($$) TOO

FOR THE OCCASIONAL USER

These latest TUTHILL units extend the advantages of our compact, original equipment design to the occasional user of pump-motor units—the industrial firm interested in individual or minimum quantity orders and prompt delivery.

TUTHILL Positive Displacement motor-and-pump units offer a wide variety of combinations for use in hydraulic, oil burning, lubricating and other services involving many different fluids. The model shown has a capacity of 90 GPH and a ¼ HP motor with a speed of 1750 RPM.

Use the attached coupon—or write TUTHILL PUMP CO.

TUTHILL PUMP COMPANY
981 East 95th Street, Chicago 19, Illinois

Please forward complete information on the new TUTHILL pump-and-driving motor units:

- ☐ for small quantity application
- ☐ for large quantity application by original equipment manufacturer
- ☐ please have your representative call

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ STATE_____

Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities from 1 to 200 GPM, for Pressures to 600 PSI, Speeds to 3600 RPM.

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois
Canadian Affiliate:
Ingersoll Machine & Tool Company, Ltd., Ingersoll, Ontario, Canada

PUMPS FOR YOUR PURPOSE

try

Don't buy oil seals haphazardly. Get Pioneer Oil Seals.
Pioneer representatives are factory trained men who can deal with any oil-sealing problem on the spot and recommend the seal you need.
Pioneer Personal Oil Sealing Service means not only studying a customer's individual needs; it also means recommending the right oil seals and personal inspection when they are in use.
Buy Pioneer and make sure your oil-sealing problems are solved for all time.

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Oilsealing & Moulding Co. Ltd.

A DIVISION OF J.H.FENNER & CO. LTD.

Factory & Head Office: Cottontree Works, Colne, Lancashire · England

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IN HYDRAULIC
CONTROL?

call the man from Webster

On America's leading tractors, Webster Hydraulic pumps have proven themselves a winner. They stand up better to such tough, demanding day after day abuse. When your hydraulic application calls for proven stamina to resist shock, with a reserve of quick response and compactness of overall design . . . be it for farm equipment or power shovels, then the man from Webster can help. Let him tell you about the complete Webster line of over 100 different positive displacement gear type pumps and fluid motors.

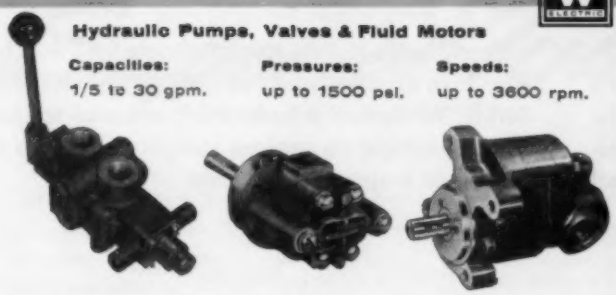
Write or call the man from Webster — a good man to have on your design team.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC
MELROSE 3-3511
RACINE · WIS

Hydraulic Pumps, Valves & Fluid Motors

Capacities:	Pressures:	Speeds:
1/5 to 30 gpm.	up to 1500 psi.	up to 3600 rpm.



FRANKLIN ADV. H102

☐ *Have THE MAN FROM WEBSTER contact us—*

- Please send the following -

☐ *Complete hydraulic catalog of pumps and valves*

☐ *New information or data as published*

Name _____
Title _____
Company _____
Street _____
City _____ State _____

TUBEXPERIENCE IN ACTION

In equipment from machine tools to harvesters,

Superior TUBING ASSURES A

More and more manufacturers are specifying bright, clean, smooth Superior tubing for their hydraulic lines—and getting dependable leakproof systems. Here's why—

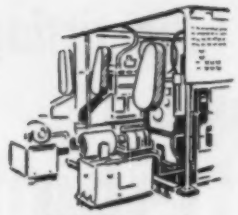
- *Offered in 156 different sizes*
- *Offered cut, multiple, straight or coiled*
- *Every length 100% hydrostatically tested*
- *Made from non-aging steel*
- *High resistance to fatigue failure*
- *Can be bent and flared easily*
- *Shipped with rust-preventive coating*
- *Produced to rigid quality standards*

Your nearest Superior warehouse distributor can give you prompt service and expert advice on tubing problems. Call him today.

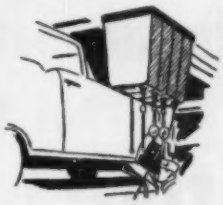
If you manufacture or repair equipment using hydraulic lines, it will pay you to look first at the many advantages Superior (SAE) hydraulic tubing offers you. Some sizes can bear working pressures as high as 12,000 psi. It is non-aging steel with maximum carbon content of only 0.12%. This gives high ductility, which permits easy bending and flaring. We furnish it in dead-soft annealed temper, in cut, multiple or random straight lengths up to 30 ft.—or longer in coiled form.

DEPENDABLE HYDRAULIC SYSTEM

Typical end products which use Superior (SAE) hydraulic tubing



MACHINE TOOLS

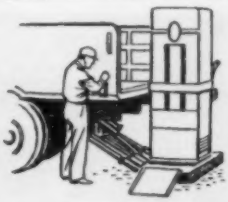


GREASE GUN LINES

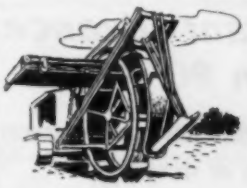
MATERIALS HANDLING EQUIPMENT

OIL WELL DRILLING EQUIPMENT

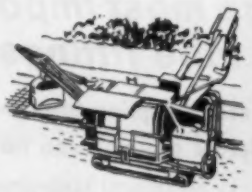
AIRCRAFT HYDRAULIC LINES



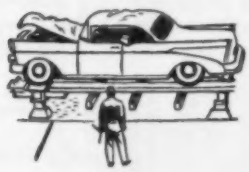
HYDRAULIC TAILGATES ON TRUCKS



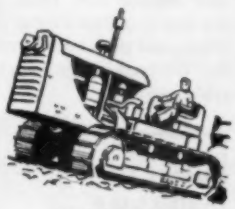
DITCHDIGGERS



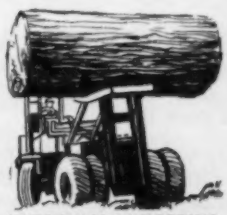
HIGHWAY CEMENT MIXERS



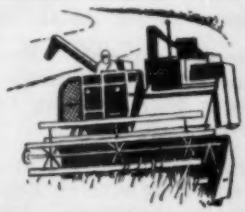
WHEEL & FRAME STRAIGHTENING EQUIPMENT



BULLDOZERS



HYDRAULIC LUMBERING LIFT TRUCK



HARVESTING EQUIPMENT

Superior Tube

The big name in small tubing

NORRISTOWN, PA.

All analyses .010 in. to ⅛ in. OD—certain analyses in light walls up to 2½ in. OD

West Coast:
Pacific Tube Company • 5710 Smithway St., Los Angeles 22, Calif. • RAymond 3-1331

SUPERIOR TUBE COMPANY
2030 Germantown Ave.
Norristown, Pa.

I want technical data on Superior (SAE) hydraulic tubing. Rush me my copy of Bulletin 39 and the reprint article "Selecting and Installing Hydraulic Tubing."

*Name*_____ *Title*_____

*Company*_____

*Address*_____

IMPERIAL HI-SEAL™

the flareless tube fitting that makes a positive butt-joint

The most important advance in tube fittings in 20 years!

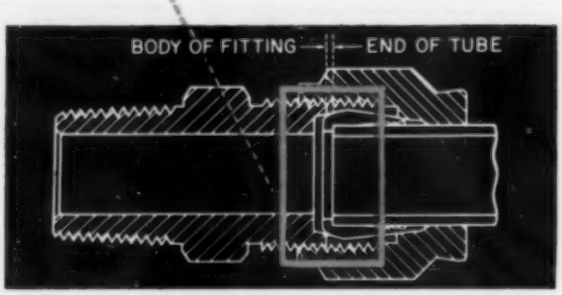
No need to spring tubing • withstands high pressures
foolproof assembly • no flaring or threading

Checks on typical high-pressure tubing jobs show you can cut installation time substantially with Hi-Seal fittings . . . *save up to 53% compared with flare-type fittings.* Hi-Seal completely revolutionizes high-pressure tubing installations!

Foolproof assembly! Pressure-tight joints and re-connections can be made even by the inexperienced. There's only *one* way tubing can be inserted into sleeve . . . only *one* way sleeve goes into fitting.

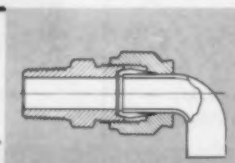
Positive butt-joint! No tube entry into body of fitting. No springing of tube. Especially important with large-diameter, heavy-wall, hard-temper tubing, or short lengths of tubing.

Closer tube bends! Butt-joint and no-flaring features mean bends can be made exceptionally close to end of tubing. Hi-Seal fittings work in close quarters where other types of fittings cannot be used!



See above how tube "bottoms" on shoulder of sleeve. Camming action of nut causes sleeve to form a collet-type triple-seal grip on tubing. Final circumferential seal is made by tapered edge of sleeve. No tube torquing when making a joint.

MEETS J.I.C. AND A.S.M.E. STANDARDS LISTED BY U.L.



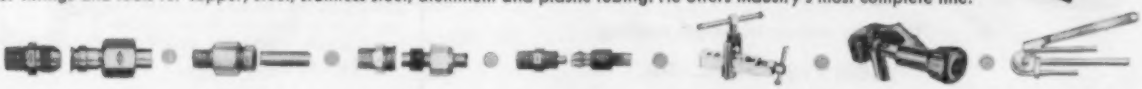
Permits Closer Tube Bends Than Any Other Fittings!

Hi-Seal fittings are furnished in steel and stainless steel — for ⅛ to 1½" O.D. tubing.

Write for Bulletin 3061 and complete facts.

SEE YOUR IMPERIAL DISTRIBUTOR:

for fittings and tools for copper, steel, stainless steel, aluminum and plastic tubing. He offers industry's most complete line.



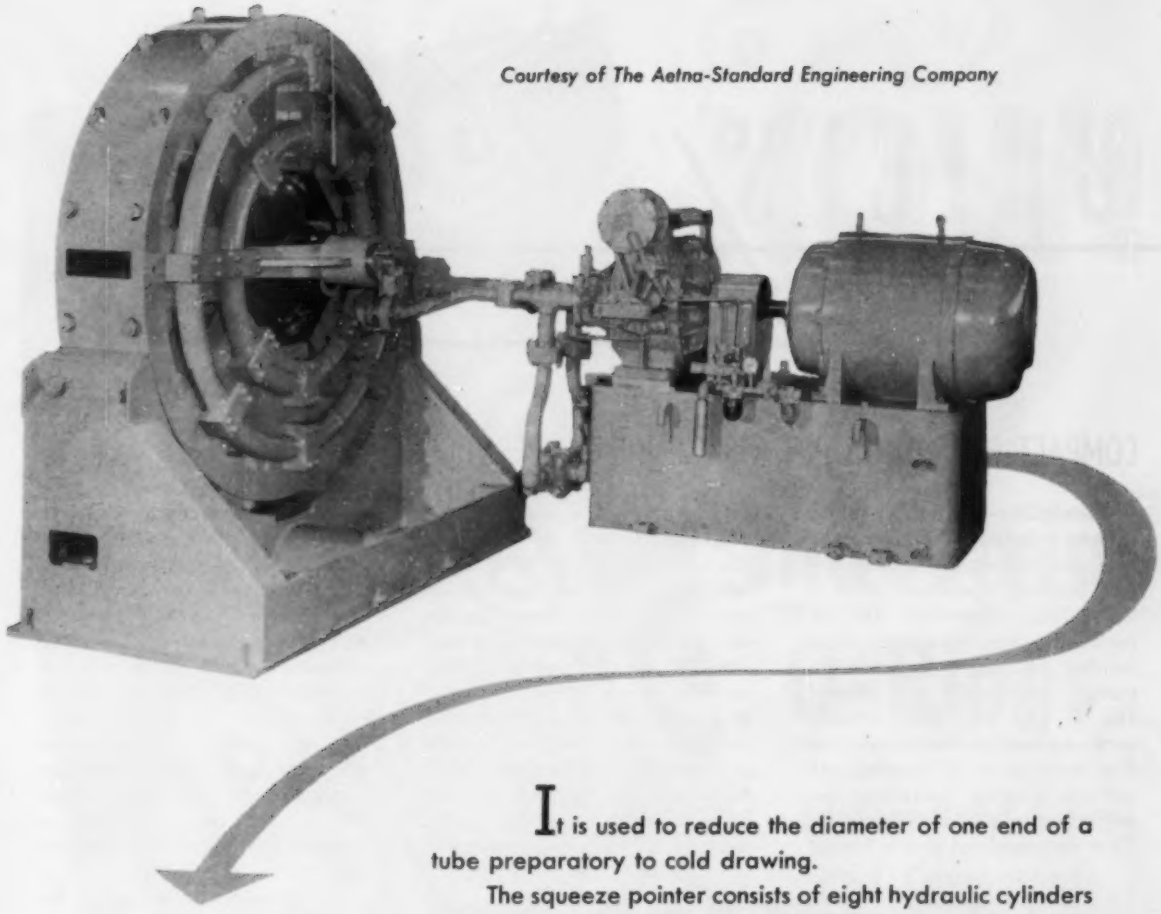
37° Flare Fitting · Hi-Duty Fitting · Flex Fitting · Poly-flo Fitting · Flaring Tool · Tube Cutter · Tube Bender

IMPERIAL

THE IMPERIAL BRASS MFG. CO.
6300 W. Howard St., Chicago 31, Ill.—Dept. AH-117

Emblem of Quality

***In Canada:* 334 Lauder Ave., Toronto, Ontario**



Courtesy of The Aetna-Standard Engineering Company

This is a SQUEEZE POINTER

It is used to reduce the diameter of one end of a tube preparatory to cold drawing.

The squeeze pointer consists of eight hydraulic cylinders uniformly spaced in a circle and acting radially toward the center. As these cylinders are reciprocated, a tube is fed into the die at the center and is thereby "squeeze pointed."

The LASSMAN hydraulic pump and control unit which powers the pointer operates under severe conditions. At a pressure of 3000 p.s.i., it causes the pointer to produce one 600 Ton "squeeze" approximately every second, yet at this frequency, the reversals are smooth, quiet and shock free.

Equally noteworthy is the fact that except when high ambient temperatures prevail, no oil cooling is required even under continuous operation.

Such service features as these point up the quality of LASSMAN hydraulic engineering and equipment which mean top performance at high efficiency and low maintenance.

We will be pleased to have your inquiries.

Quality EQUIPMENT for *Quality* PERFORMANCE

BENJAMIN LASSMAN & SON Route 8, GLENSHAW, PA.

BRIEFS about fluid power

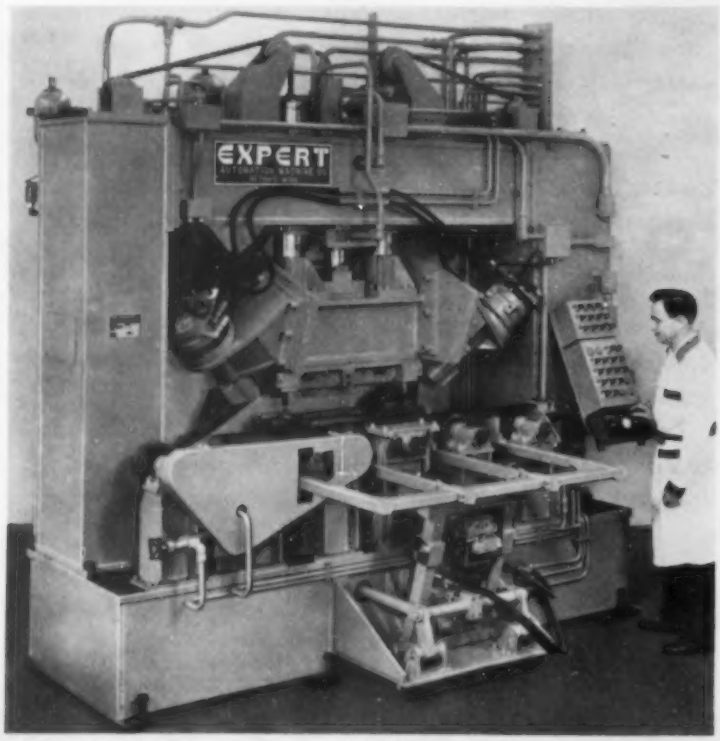
COMPACT HYDRAULICS PERMITS COMBINED OPERATIONS

• **Flexibility**—on this in-line transfer forming machine, an overhead hydraulic ram performs one bending operation while a hydraulically operated die set performs the remaining three bending operations. Expert Automation Machine Co. Div., Expert Die & Tool Co., Inc., Detroit, used hydraulics extensively in this machine, so all bending and contour forming operations are performed in one working station. Thus the completed part is formed while it is still at the required temperature for bending. With this hydraulic design, the machine can be adapted to a variety of parts by merely changing the die set. Two 15-hp-hydraulic power units operate all movements of the machine.

• **Loading**—Parts to be formed are automatically fed from furnace to transfer mechanism. This mechanism is operated by two hydraulic cylinders which lift the mechanism vertically by means of a bell crank type linkage and move it into the machine in a horizontal plane. Transfer mechanism then moves vertically downward and places the hot bar in the fixture.

• **Forming**—Four bends and contours are made on the hot bar by means of an overhead ram and an underslung die set. to begin forming operations, the ram moves downward and forms a concave contour in the bar. With the ram still in the down position, a hydraulically operated center die then moves up and produces a curve in the center section of the bar. Two hydraulically operated cone benders then form a 90° offset angle on the bar ends. Two hydraulically operated edge benders then further displace the bend to required dimensions in the tangent plane of the cone.

▼▼▼



Hydraulic Joggler Has Internal Ram

An improved, hydraulically operated joggler is being manufactured by the Hufford Corp., El Segundo, Calif. This unique machine can apply an adjustable-length stroke in any desired direction around a full circle in a vertical plane.

• **Ram**—Unit is built in two symetrical halves along a vertical centerline. One half is stationary, the other slides. Motion is imparted by an internal hydraulic

Continued on page 32

NOW!

C/R Industrial O-Rings

in Standard Sizes and Compounds

Through the years Chicago Rawhide has developed a reputation for designing and compounding special O-rings to solve special sealing problems. Now, C/R offers O-rings in a full range of standard industrial sizes and compounds, and assures you of the superior quality, service and dependability that have made Chicago Rawhide the leader in fluid sealing.

Write today for your free copy of the new C/R O-Ring Bulletin.
It lists standard O-rings keyed to the new, uniform dash numbering system in accordance with SAE Aeronautical Recommended Practice 568 as well as the 6227, 6230 and 6290 series sizes. It also lists C/R compounds formulated for a broad range of industrial purposes with hardness ratings, compatibility, temperature ranges, and typical O-ring installation details.

SEE OUR CATALOG IN SWEET'S PRODUCT DESIGN FILE OR WRITE FOR COPY

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CHICAGO RAWHIDE MANUFACTURING COMPANY
1203 ELSTON AVENUE • CHICAGO 22, ILLINOIS
Offices in 55 principal cities. See your telephone book.

OTHER C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-Metallic Gears

O-RING C/R DIVISION
CHICAGO RAWHIDE

NEW fulflo

all-steel valve . . . for greater safety!

Install it . . . Forget it
For dependable pressure control

New Fulflo all-steel piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models up to 2" pipe size. They are quiet, non-chattering because of shear-closing action. They offer greatest safety . . . even when subjected to extreme heat. Priced right for original equipment use . . . built right for superior replacement service.

THE FULFLO COMPLETE LINE

- Standard and flanged models
- Steel, cast iron or brass bodies
- Pipe sizes to 2½"
- Just 6 springs for pressures to 500#
- Brass, steel or stainless pistons
- *Specials* to your requirements

Specify FULFLO for Positive Automatic Pressure Control

Write for free helpful reference:
"FULFLO VALVES MECHANICAL DATA BOOK"

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Avenue, Blanchester, Ohio

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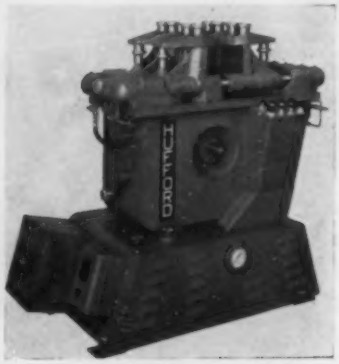
BRIEFS / continued

ram which can be rotated end-for-end in a vertical plane through a full 360°. This ram forces the sliding half of the machine in any desired direction—up, down, horizontally, or at any angle between. Ram direction is adjusted manually by crank. Direction of stroke is indicated on a dial linked with the ram rotation mechanism.

• **Stroke**—To make any joggle the operator simply dials the correct stroke direction and adjusts



the stroke length for thickness of stock. These facts are easily recorded and settings can thereafter be duplicated for re-runs.

• **Vise**—Various workpiece shapes are gripped by first casting vise blocks from a low melting point alloy. The vise jaws are hydraulically retracted after joggling, to remove the workpiece.

• **Specifications**—Maximum stroke length is ½-in. Load capacity is 18,000 pounds. Unit is powered with a 1½ hp, 60 cycle, 220-240 v, 3-phase motor and weighs approximately 1200 pounds. ▼▼▼

Parker Appliance Acquires Hannifin

An agreement for Parker Appliance Company, Cleveland, to purchase Hannifin Corporation, Des Plaines, Ill., was announced by S. B. Taylor, president of Parker, and E. G. Peterson, president of Hannifin. Purchase price will be approximately $7,500,000.

Continued on page 37

Circle 50 on Reader Service Card

Circle 92 ⟶

Miller®

4 New Hydraulic Cylinder Features Benefit You 9 Ways ...At No Added Cost

MORE MILLER "FIRSTS"

NEW! ALL TEFLON SEALED AGAINST EXTERNAL LEAKAGE...

1. Eliminates Seal Damage from Fluids—Teflon is Impervious to all Hydraulic Fluids (Including Fire-Resistant Types) . . . Hydraulic Cylinders with Teflon Piston Cups Slightly Higher.
2. Eliminates Seal Damage from High Temperatures—Teflon Sealed Cylinders Operate At —100° F. to 500° F.

NEW! ROD BUSHING SEAL . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at Extreme Pressures.

NEW! SHEF SEAL AT TUBING ENDS . . .

1. Eliminates Shearing of "O" Ring in Re-Assembly
2. Eliminates Extrusion of "O" Ring at ANY Pressure—Teflon Sealing Ring is Backed Up by Zero Clearance Metal Shoulder.

NEW! LOCK-SEAL CUSHION ADJUSTMENT SCREW . . .

1. Eliminates Screw Projection Beyond Head and Cap—Cylinders Mount on Any Side.
2. Eliminates Manual Sealing and Locking After Flow Adjustment—Teflon Seal is Self Regulating and Self Locking.
3. Eliminates Accessibility Problems—Cushion Screw Interchangeable with Ball Check Position—Adjustable Through Small Wrench Hole Drilled in Interfering Machinery.

du Pont trademark for its fluorocarbon plastic TFE-6

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Turn Page For Cross Section Of SHEF SEAL

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

- Case-Hardened Chrome Plated Piston Rod
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers
- Interchangeable Square Design

MILLER FLUID POWER
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2008 N. Hawthorne Ave., Melrose Park, Ill.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

Miller®

Announces a New Space and Price Saving Hydraulic Cylinder Line

SAVE UP TO 76% OF COST

Heavy Duty Model LH—Same Size As Ordinary Gasket Type Square Design Low Pressure Cylinders			
BORE	NORMAL RATINGS	NON-SHOCK INTERMITTENT RATINGS	YOU SAVE THIS % IN PRICE OVER STANDARD 2000-3000 PSI CYLINDERS
1½"	1500 PSI	2500 PSI	27%
2	1500	2500	27%
2½	1000	1500	28%
3¼	1500	2500	32%
4	1000	1500	35%
5	800	1200	37%
6	800	1200	43%
8	500	800	50%
10	500	800	71%
12	500	800	76%
14	500	800	*Not Available in 2000-3000 PSI*

MORE MILLER "FIRSTS"

Miller®

Announces 50% More Power Per Cylinder Dollar

with Extra Heavy Duty

3000-5000 PSI MODEL H HYDRAULIC CYLINDERS

Same Price and Mounting Dimensions as Miller 2000-3000 PSI Hydraulic Cylinders.

BOTH LINES MADE POSSIBLE BY SHEF SEAL

Write For New Hydraulic Cylinder Bulletin

MORE MILLER "FIRSTS"

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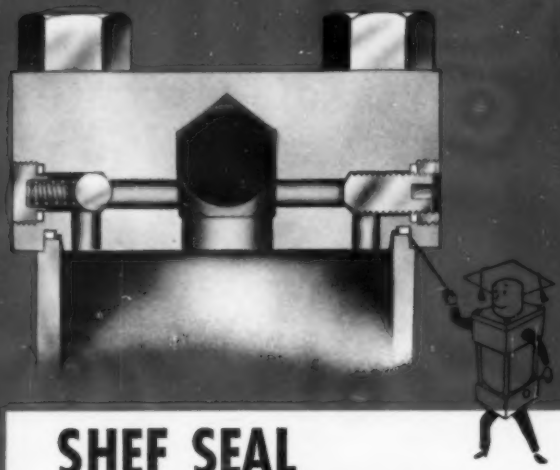
MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

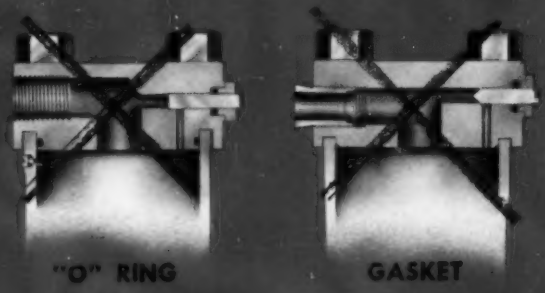
AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

OTHER MILLER QUALITY FEATURES

- All Teflon Sealed Against External Leakage—Teflon Cups Extra
- Case-Hardened Chrome Plated Piston Rod
- Shear Proof Rod Bushing Seal
- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

SHEF SEAL Obsoletes All Other Hydraulic Cylinder End Seals . . . *at no added cost*





SHEF SEAL
HAS EVERY ADVANTAGE

NONE OF THE DISADVANTAGES OF OBSOLETED "0" RING AND GASKET CONSTRUCTION

Shearproof! Location of Teflon sealing ring eliminates blind assembly, makes shearing impossible. One sealing ring cross section dimension for all cylinder sizes—supplied on convenient spools.

Blind "0" ring assembly can shear rings and create difficult servicing problems. Large inventory required for servicing varying cylinder bores. Gasket construction unpredictable—outlawed by J. I. C. eight years ago.

Heatproof! Teflon sealing ring provides leakproof sealing at temperatures from —100° F. to plus 500° F.

Gaskets and "0" rings require extra inventories of special synthetic compounds to meet various operating temperatures.

Extrusionproof! Zero metal-to-metal clearance at all pressures provides perfect seal backup. Sealing ring cannot extrude at any pressure, permitting higher operating pressure ranges.

Gaskets can leak and blow even at low temperatures. "0" ring extrusion is one of the most prevalent causes of hydraulic cylinder repairs and maintenance.

Fluidproof! Teflon sealing ring seals perfectly and permanently against all known hydraulic fluids including fire-resistant types.

"0" rings must be specially compounded for use with different hydraulic fluids. This means large, expensive inventories.

OTHER DESIRABLE FEATURES

SHEF SEAL is a pressure energized seal—its sealing effectiveness increases with pressure. It allows air bleeds in head and cap for remote or automatic bleeding. Its zero metal backup clearance eliminates dangerous leaks and spurts of fluid due to seal failure. Head and cap axial movement does not destroy seal.

ELIMINATE THESE DISADVANTAGES

"0" ring construction requires location of air bleeds in cylinder tubing. Failure of gaskets and "0" rings causes leaks and spurts of fluid that create dangerous fire and safety hazards.

SHEF SEAL—*Another Miller "First"*

S SHEAR PROOF
H HEAT PROOF
E EXTRUSION PROOF
F FLUID PROOF
SEAL
Teflon Pressure Energized
Hydraulic Cylinder Tubing End Seal
PAT. APPLIED FOR

OTHER MILLER QUALITY FEATURES

- All Teflon Sealed Against External Leakage—Teflon Cups Extra
- Case-Hardened Chrome Plated Piston Rod
- Shear Proof Rod Bushing Seal
- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

Turn Page For More About MILLER

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

Miller

All Teflon Sealed —Perfect Sealing for Hydraulic Cylinders

HAS EVERY ADVANTAGE...

Teflon—As Static and Dynamic Seals

1. Impervious to Every Hydraulic Fluid Including Fire-Resistant Types.
2. Seals Perfectly in Cylinders at Temperatures from —100° F. to 500° F.
3. Can Be Molded Into Shapes That Have Zero Leakage—Hold Pressure Indefinitely.
4. With Proper Design of External Seal Cavities, Teflon Can Be Included *Without* Increasing Prices. Miller Provides Teflon for all External Seals at Prices Competitive with Ordinary Cylinders. Leather Internal Piston Cups are Standard (Teflon Cups Extra).

Copyright 1957—Flick-Reedy Corporation
Printed in U.S.A.

•du Pont trademark for its tetrafluoroethylene resin.

When you buy Miller
You buy extra years
of worry-free
Cylinder performance
...at competitive prices

NONE OF THESE DISADVANTAGES

Synthetic Rubber— As Static and Dynamic Seals

1. Unsatisfactory Except When Used With A Limited Range of Hydraulic Fluids.
2. Even Uncontrollable Changes in Fluid Additives Often Destroy Seal.
3. Specific Compounds Needed for Compatibility with Specific Fluids Normally Used Today.
4. Normal Temperature Range Limited to 0° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Greatly Reduced Life at 150° F. to 250° F.
5. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.
6. "U" Type Seals Without Mechanical Retainer at Mid-Section Frequently "Roll" and Lose All Sealing Ability.

Resin Impregnated Leather— As Dynamic Seals Only

1. Is Compatible with Many—But Not All—Hydraulic Fluids and Additives Including a few Fire-Resistant Types.
2. Normal Temperature Range Limited to —60° F. to 130° F. Slightly Reduced Life When Operated at 130° F. to 150° F. Substantially Reduced Life at 150° F. to 250° F.
3. External Leakage Causes Fire and Safety Hazards When Temperature or Fluid Destroys Seals.

   Miller Uses Leather Piston Cup Seals for Internal Sealing... Standard Price (Teflon Cups Extra).

Piston Rings— As Dynamic Internal Seals

1. Most Piston Rings Allow Some Leakage.
2. Allow "Slip" or "Drift" of Piston Due To Leakage—Unsatisfactory for Many Applications.
3. Allow Varying Feed Rates Due To Leakage Because Of Viscosity Change During Startup—Unsatisfactory for Most Multiple and Automated Operations.
4. Allow Some Pressure Loss.
5. Chips and Dirt Enter Space Between Piston and Tube Causing Scoring —Especially During Startup.

Write For New Hydraulic Cylinder Bulletin

OTHER MILLER QUALITY FEATURES

- All Teflon Sealed Against External Leakage—Teflon Cups Extra
- Case-Hardened Chrome Plated Piston Rod
- Shear Proof Rod Bushing Seal
- Ball Check Interchangeable with Self Sealing and Locking Cushion Adjustment
- Rust Resistant Surfaces
- Teflon Oil and Dirt Wipers

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION
2008 N. Hawthorne Ave., Melrose Park, Ill.

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

BRIEFS continued

Parker makes many types of products to control or confine the flow of liquids, gas, or air, under pressure. Hannifin is one of the oldest and largest manufacturers of hydraulic and pneumatic cylinders, presses, and components.

Taylor stated the combined Parker-Hannifin line would provide a broad range of products and should result in a 50/50 balance between aircraft and industrial sales. He expects combined sales to reach $40,000,000 a year. ▼▼▼

Continued on page 40

BRIEF NOTES

BONDABLE TEFLON . . . adheres to aluminum, mild steel and plastics. The process, developed by Abbott & Biddle, Philadelphia, alters the surface of Teflon so it can be used with conventional adhesives. Should be useful for lining tanks, pipes, ducts; facing valves, machined parts, and similar applications.

MINIATURE O-RING . . . .042-in. ID x .050 cross-section, is one of many items manufactured by E. F. Houghton & Co., Philadelphia, to meet industry demand for very small rubber moldings.

TOOL ENGINEERING SEMINARS . . . sponsored by the American Society of Tool Engineers, will cover timely subjects of importance to tool engineers and manufacturing personnel. All seminars will be made available to ASTE chapters as a packaged unit.

$½ MILLION FOR RESEARCH . . . American Brake Shoe Co. is currently spending this amount in metallurgical research to improve strength and wearing qualities of metals.

IMPROVED BUTYL RUBBER COMPOUND . . . developed by U. S. Rubber Co., will withstand 700 F for short periods of time and 400 F for sustained periods. Material shows promise for use in gaskets, seals and diaphragms.

BUSINESS BRIEFS

RACINE HYDRAULICS ADDS ELECTRONIC CONTROLS . . .Electronic pickups which will sense the power needs of mechanized equipment and activate the pumps which hydraulically power such machinery, are to open a whole new field according to John E. Erskine, executive vice president, Racine Hydraulics & Machinery, Inc., Racine, Wis.

FLICK-REEDY SALES INCREASE 14% . . . Frank Flick, president, reported gross sales of $5,588,280 for the year ending June 30, compared with $4,901,633 for the previous year.

RELIANCE ELECTRIC and MASTER ELECTRIC CONSOLIDATE . . . Edward E. Helm, president of Reliance Electric & Engineering Co., Cleveland, and Daniel T. Warner, president of Master Electric Co., Dayton, Ohio, jointly announced the combination. Consolidation will be effected by exchange of 450,000 shares of Reliance for the assets of Master, equivalent to .67637 shares of Reliance for each share of Master.

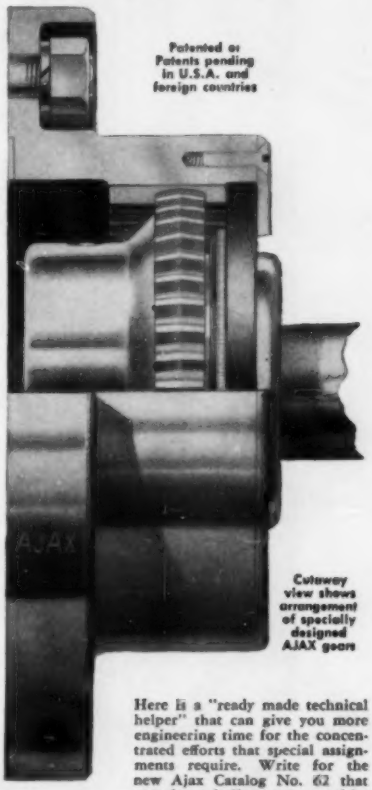
SALES UP $2 MILLION . . . Consolidated net sales of Square D Co. for the first six months of 1957 were $50,696,210, compared to $48,446,620 for the corresponding period in 1956. Durnig this first half, new facilities in Milwaukee and Atlanta began operations.

AJAX

Self-aligning

DIHEDRAL COUPLINGS

Short Cut to Major Product Improvement

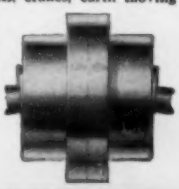


Cutaway view shows arrangement of specially designed AJAX gears

Here is a "ready made technical helper" that can give you more engineering time for the concentrated efforts that special assignments require. Write for the new Ajax Catalog No. 62 that contains misalignment capacities of every coupling size and type in the complete line of Ajax Dihedral Couplings. Why spend valuable time duplicating data already established by thousands of proven, field tested applications.

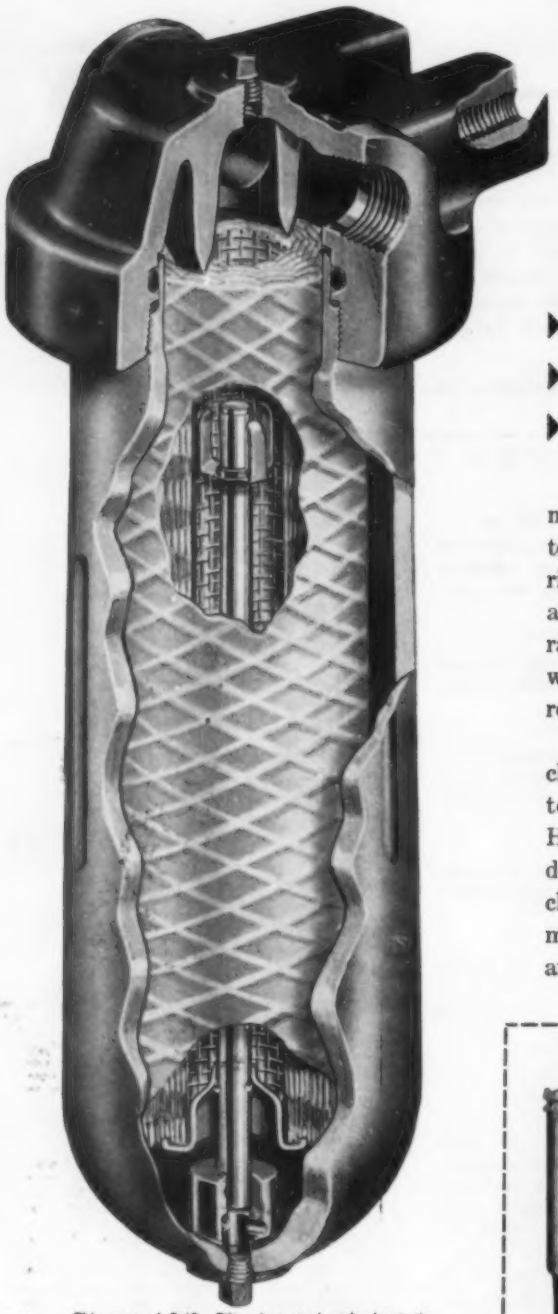
Ajax Dihedral Couplings handle unavoidable shaft misalignment, angular and offset, up to a total of 12°. Teeth can be cut to handle greater misalignment capacities on special order.

Get the facts on how manufacturers of presses, machine tools, rolling mills, cranes, earth moving and many other direct connected machines are simplifying design, cutting manufacturing costs and improving product performance with Ajax Dihedral Couplings.



Write today for your personal copy of Bulletin No. 62.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK



This rugged Fulflo Filter is tested at hydrostatic pressure of 10,000 pounds per square inch — to assure safety at operating pressures up to 4000 psi.

USE Fulflo FILTERS WHEN YOU WANT

- Continuous Micronic Clarity
- At the Flow Rate and Pressure
- Your Operations Require

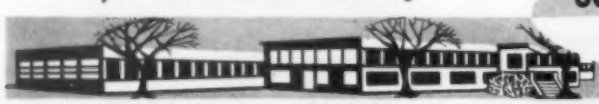
There's a Fulflo Filter to meet your exact needs for micro-fine filtration of any hydraulic fluid — to protect precision parts and extend fluid life. A wide variety of standard models handle all normal flow rates and pressures. Special models are engineered for flow rates up to 2000 gpm or pressures as high as 5000 psi, with minimum pressure drop. Fulflo Filters do *not* remove additives from oils.

Fulflo Filters are especially designed for micronic clarification of fluids used where exceptionally precise tolerances are involved. Fulflo Filters employ Honeycomb Filter Tubes in a wide range of controlled densities to give you the exact degree of micronic clarity you need. For specific applications, special models can be engineered in a variety of sizes (single and multi-tube), containers and elements.

The complete line of Commercial Filters products includes CFC Honan-Crane Hydraulic Oil Filters. Filter medium is Cranite (Fuller's earth) for non-additive oils, or Palconia for additive oils. CFC Filters quickly pay for themselves by preventing excessive wear of hydraulic parts, and safeguarding against clogged valves and mechanisms.

Commercial Filters Engineers are ready to help you with any problems involving fine filtration of hydraulic fluids. For technical literature, write to Department AH.

Micro-Fine Filtration for Low Cost Clarity



COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

Plants in Melrose, Massachusetts and Lebanon, Indiana

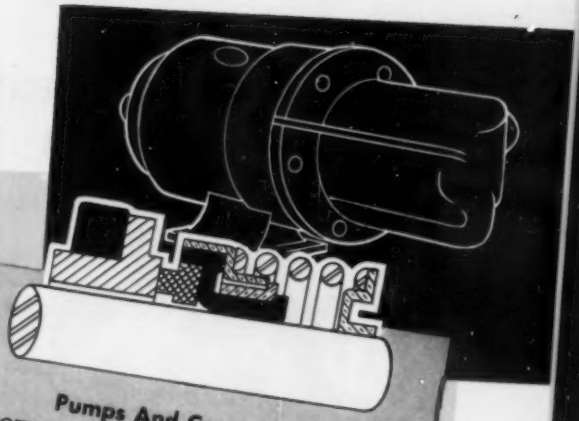
FULFLO FILTERS WITH GENUINE HONEYCOMB FILTER TUBES FOR CONTROLLED MICRONIC CLARITY • CFC MULTI-CARTRIDGE OIL FILTERS
PURIVAC INSULATING OIL CONDITIONERS • DRI-PURE WATER-OIL SEPARATORS • PRE-COAT FILTERS • MAGNETIC SEPARATORS

Circle 33 on Reader Service Card

Circle 56 ➔

Machine Tools And Power Transmission Equipment

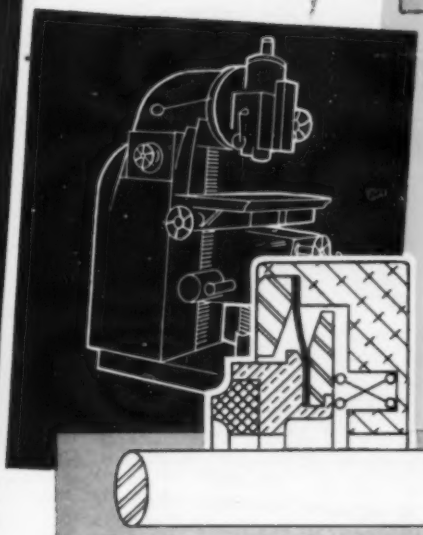
STYLE GU — A packaged sealing unit containing both rotating and stationary seal faces enclosed in metal housing. Stock sizes for shafts .250 through 4.000.



Pumps And Compressors

ROTO-FLEX — Rugged flexibility. Only 3 parts. Single or double units. Stock sizes for shafts .250 through 4.000.

STYLE RFO — A specially designed Roto-flex seal, for installation outside the stuffing box. Stock sizes for shafts .250 through 4.000.



Heavy Machine Tools

STYLE DPC — A high-speed, carbon-faced seal, for more compact installation in heavy industrial machinery. Stock sizes for shafts .250 through 4.000.

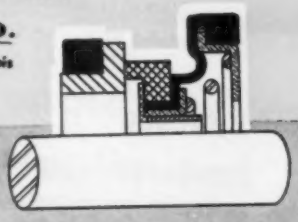
A Complete Line
GITS SHAFT SEALS
For Every Application

These modern, mechanical, face-type seals are carried in stock — to save you time and money. Write for detailed data.

GITS BROS. MFG. CO.

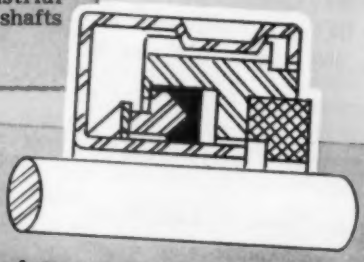
1846 South Kilbourn Avenue • Chicago 23, Illinois

Specialists In Lubricating Devices And Shaft Seals For Almost Half-A-Century



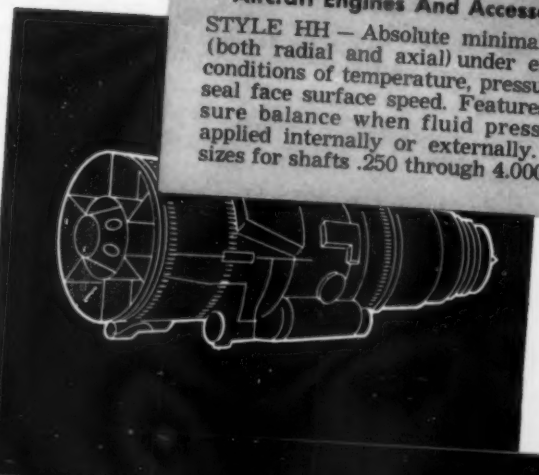
Household Appliances

STYLE SGU—A factory-assembled unit-type seal for the small-budget user. Stock sizes for shafts .250 through 1.000.



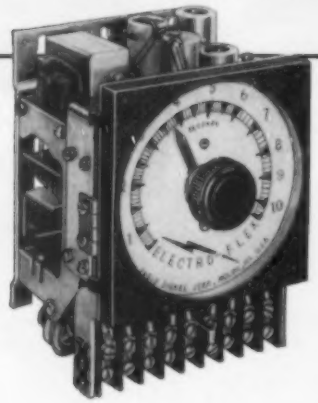
Aircraft Engines And Accessories

STYLE HH — Absolute minimal space (both radial and axial) under extreme conditions of temperature, pressure and seal face surface speed. Features pressure balance when fluid pressure is applied internally or externally. Stock sizes for shafts .250 through 4.000.



NEW *EAGLE* ELECTRONIC RESET TIMER SPANS RANGE FROM .1 TO 10 SECONDS

. . . COMPENSATED CIRCUIT MAINTAINS HIGH ACCURACY



ELECTROFLEX

Eagle's new Reset Timer employs only two moving parts (relay armatures), achieving precise short-interval timing through a dual range electronic circuit. Timing accuracy is maintained within 2% through line voltage variations from 90 to 130v. ambient temperature changes of 52°F. to 140°F., electronic tube replacements, and vibration up to 3g.

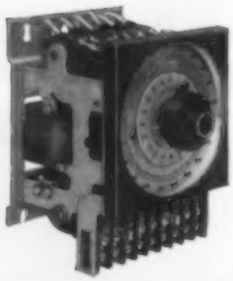
SUGGESTS NEW CONTROL IDEAS

Electroflex Dial, with precision wound potentiometer, may be mounted at the push button station with the mechanism located at a spot more convenient to wiring, installation.

PULSER

Pulsing with adjustable dwell is easily effected. Periodic output pulses may be continuously repeated with the OFF period adjustable on the dial. Pulse length (or reset time) is .050 seconds. OFF time is adjustable to 10 seconds.

COMPANION EQUIPMENT



The Electroflex Timer, the Eagle Microflex Timer, synchronous motor driven for longer time intervals, and the Microflex Counter, (shown) all share the same large 4" dial, mounting dimensions, accessories and selection of enclosures to provide uniform appearance, simplify installations.

Send for new Eagle Bulletin 150. Simply write to Eagle Signal Corporation, Industrial Timers Division, Moline, Illinois, Dept. AH-1157.

BRIEFS continued

All-Hydraulic Truck Crane

This truck crane, being fully hydraulic, requires only 15 inches of space between the cab and the truck bed, leaving the entire truck bed open for payload. Designated the Hiab 170 by Stanco Manufacturers & Sales, Inc. of Los Angeles, the unit can be operated

by one man. Boom length is easily adjustable through hydraulic control, and the hydraulic-powered crane has a range of lifting capacities from 6000 lbs on a shortened boom of 5 ft, to 2500 lbs on the full boom of 13 ft. Hydraulic control makes the crane action positive and accurate through a 360° swing. Standard equipment includes hydraulic outriggers for handling heavy loads. ▼▼▼

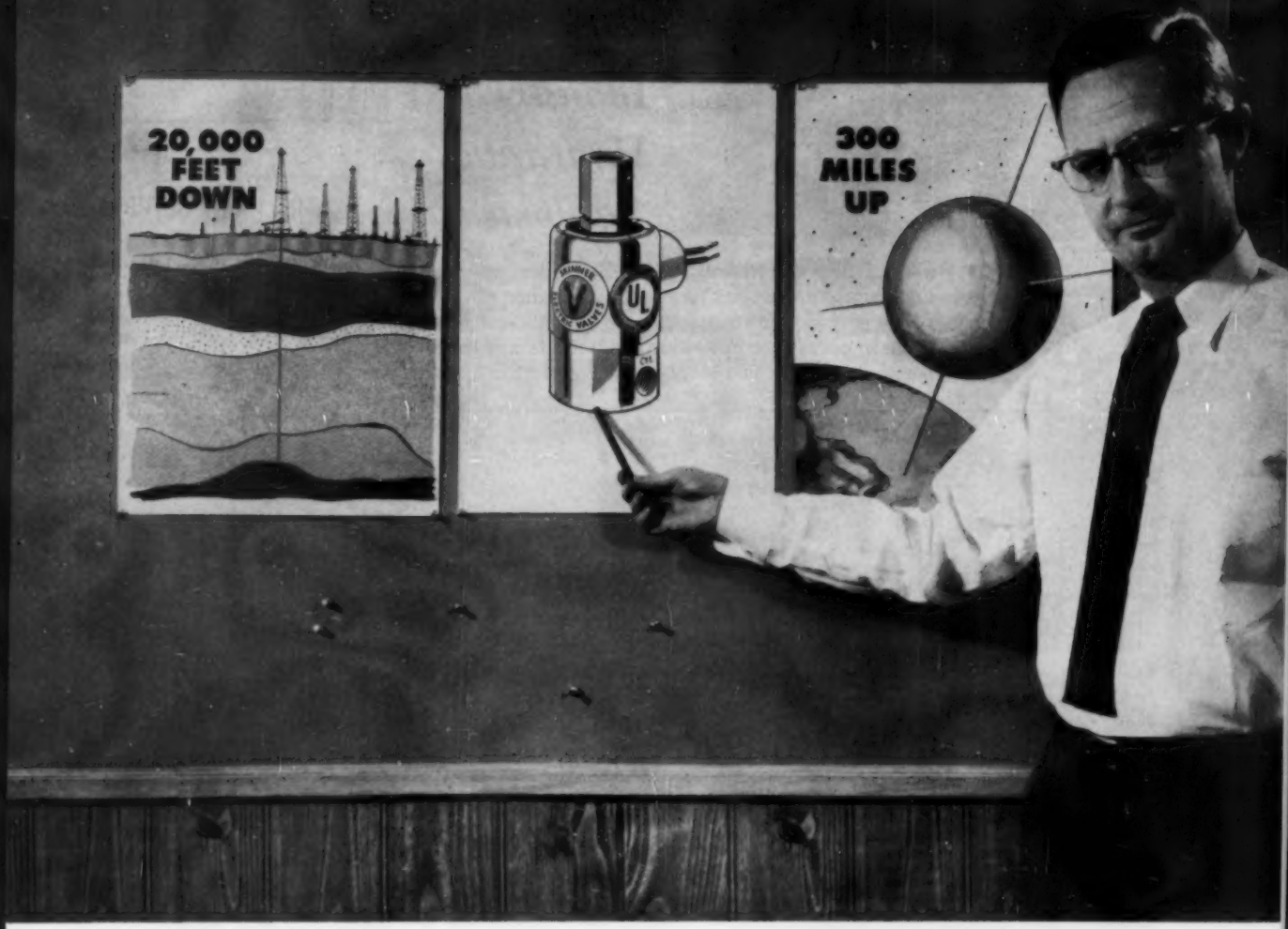
Bellows Company Purchased by IBEC

International Basic Economy Corporation, New York, has purchased The Bellows Company, Akron, Ohio, and its affiliated companies and divisions. Announcement of the transaction was made jointly by Nelson A. Rockefeller, president of IBEC, and H. B. Link, president of Bellows. Bellows is a leading manufacturer of pneumatic, hydraulic and electrical equipment for automated production. International Basic Economy Corp. is an international finance and development firm. Present management of The Bellows Co. will continue. ▼▼▼

Continued on page 42

Circle 41 on Reader Service Card

Circle 125



The versatile design of Skinner Solenoid Valves makes their applications almost unlimited

Skinner Solenoid Valves have such great versatility that no one, not even their makers, knows the full extent of their applications. The range of their extremes demonstrates this vividly. One Skinner valve is being used in an instrument in Texas oil wells that tells the nature of earth strata 20,000 feet below the surface. Another one will be used to help launch the satellite that soon will be circling the globe.

If you have a problem that a solenoid valve might conceivably solve, we urge you to talk to a Skinner representative. Fill him in on the nature of your application. He'll be glad to work with you in selecting a valve that matches your requirements as to port sizes and locations, voltages, pressures, temperature conditions, flow adjustments and mountings.

For complete information on Skinner's line of 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 31N.

Skinner Solenoid Valves are distributed nationally

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN
CONNECTICUT
105 EDGEWOOD AVENUE

THE CREST OF QUALITY

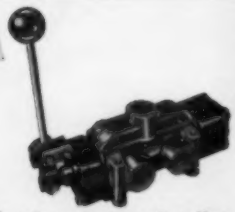
ADEL *Industrial Hydraulic Equipment*

for PEAK PERFORMANCE ADEL Hydraulic Valves and Pumps are setting new and ever higher standards for precision in manufacturing and efficient performance in operation. Following are but a few of the wide variety of models to meet all operating conditions.

GEAR-TYPE HYDRAULIC PUMPS

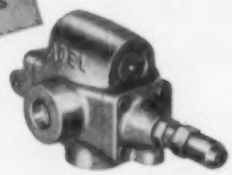
For 1000 psi service with rated capacities at 1800 rpm of from 1.5 to 46.8 gpm.

DIRECTIONAL CONTROL VALVES



4-way valves with spring-centered, spring-offset, and 1, 2, or 3 position detent action. 1500 psi. Flows to 28 gpm.

BY-PASS VALVES



Relief, Sequence and Unloading valves. Direct or remote operation, 50 to 1500 psi range.

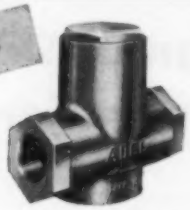
VOLUME (FLOW) CONTROL VALVES

Compensated type maintains constant flow over wide differential pressure range. No drain line required. 1500 psi.

PILOT VALVES

2 or 3 position detent. With or without dog or lever. Can be used as 4-way valve in small circuits. 1000 psi.

CHECK VALVES



Valves allow free flow in one direction only. Many variations available. 3000 psi.

Reliability

ADEL PRECISION PRODUCTS

A DIVISION OF GENERAL METALS CORPORATION

BURBANK, CALIFORNIA • HUNTINGTON, WEST VIRGINIA

Manufacturers of MARINE & INDUSTRIAL HYDRAULIC CONTROL EQUIPMENT

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Pawtucket, Rhode Island

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UTAH •
Robert Taylor & Sons
Salt Lake City 10, Utah

WASHINGTON •
Haskel Engineering & Supply Co.
Seattle, Washington

BRIEFS / continued

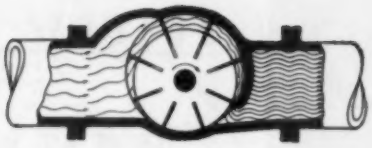
Giant Test Machine

A radial-piston hydraulic pump, driven by a 10-hp electric motor, supplies hydraulic fluid at 3000 psi to the main cylinder of this machine. This pulls the loading head down, exerting a tremendous force through a power

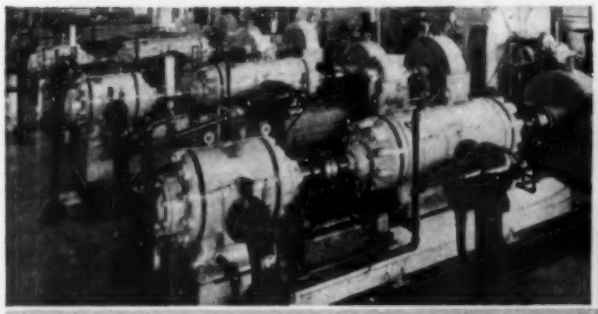
stroke of 36 inches at a maximum rate of 2.5 ipm. Available energy is so delicately controlled that an egg can be compressed without breaking the shell. Machine was built by Baldwin-Lima-Hamilton Corp., Eddystone, Pa. for extensive strength evaluation of large aircraft components at Lockheed's Georgia Division, Atlanta. ▼▼▼

Continued on page 44

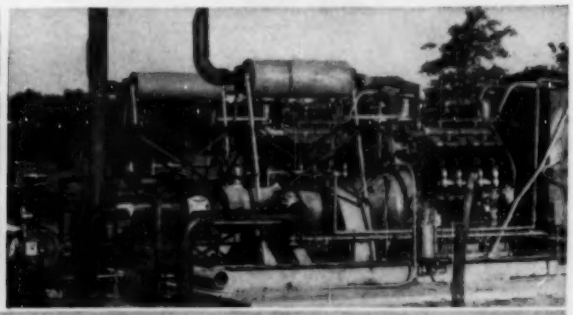
Hydraulic lift cylinders quickly elevate mobile loading ramps. Manufactured by Magline, Inc. of Pinconning, Mich., the ramps are 30 to 36 ft. long, with loading capacities from 7000 to 16,000 pounds.



This simple rotary principle . . . makes the **FULLER** Compressor incomparable



IN-PLANT SERVICES

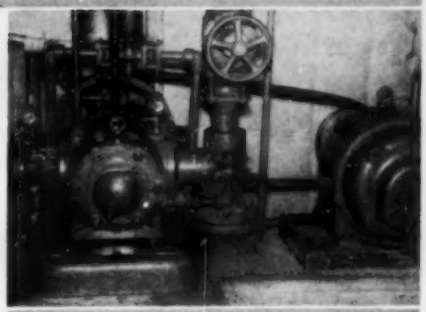


GAS GATHERING

The remarkable record of Fuller Rotary Compressors wherever they are used–indoors or out–goes back more than 25 years. Outstanding dependability in operation is based on simplified design. They consist essentially of an eccentrically mounted rotor in a cylinder to form a crescent which is divided into sections by the rotor blades. Each section formed by the rotor blades carries air through the crescent with no reversal of air flow and with measurable improvement in volumetric efficiency. Rotor blades move smoothly by centrifugal force and automatically compensate for wear.

It's as simple as that and the savings realized are significant–in operation and maintenance. Fuller Rotaries operate indefinitely and are literally carefree. They are available in a range of sizes for plant services, refrigeration and gas gathering.

Clip, fill in and mail coupon for detailed information about Fuller Rotary Compressors for plant service, refrigeration or gas gathering.



REFRIGERATION

COST-SAVING ADVANTAGES

1. Smooth, pulse-free, one-way air flow.
2. Lack of vibration permits use of light foundation.
3. Far fewer moving parts insure low maintenance.
4. Small size for high capacity permits installation in minimum space.
5. Direct drive further reduces space requirements.
6. Valveless design permits continuous-unsupervised operation and greatly reduces maintenance costs.

Fuller Rotary Compressors:

- Maintain original capacity for the life of the machine.
- Provide a high degree of reliability, thereby reducing standby capacity requirements.
- Have few moving parts, thus sharply reducing parts inventory.
- Require minimum supervision and inspection.

It will pay you to compare Fuller Rotaries with other compressors and evaluate Fuller advantages to your operation in terms of annual net savings. Fuller Rotaries are available for industrial pressures to 125 psig and capacities to 3300 cfm. We will be glad to supply you with facts based on actual experience with Fuller installations over the past 25 years.

FULLER COMPANY
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Please send me, without obligation, descriptive literature on the Fuller Rotary Compressor. I am specifically interested in:

☐ Plant Services ☐ Refrigeration ☐ Gas Gathering

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Selecting the right hydraulic component for each requirement takes years of experience — years of hydraulic system design and application. Picking the right supplier for all your needs is another problem sometimes solved by using more than one source. The common denominator for all your hydraulic problems can be the product line and experience background of H-P-M. A complete line of pumps, power units, valves, cylinders and accessories plus 77 years of hydraulic experience is the answer in most cases. When you're planning hydraulically, call on H-P-M. Write today for Bulletin 1101 — the handy condensed catalog of the complete H-P-M line.

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THE HYDRAULIC PRESS MFG. CO.

Mount Gilead, Ohio, U.S.A.

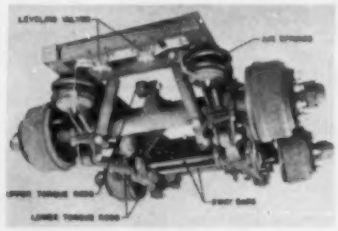
A DIVISION OF KOEHRING COMPANY

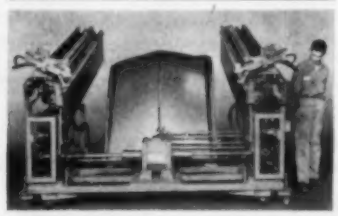
1877—1957

BRIEFS continued

Trailer Air Suspension System

Units are packaged assemblies of frame, air springs, reservoirs, shock absorbers, filters, leveling valves, and sway bars, designed by Clark Equipment Company's Automotive Division for simple installation on new equipment or operating trailers. Air reservoirs are integral parts of the unit, and air is delivered to each reservoir by a common line from the tractor's compressor. Each reservoir in turn serves one side of the air suspension independently of the other. Thus, the trailer bed remains level both laterally and vertically under all load conditions. ▼▼▼





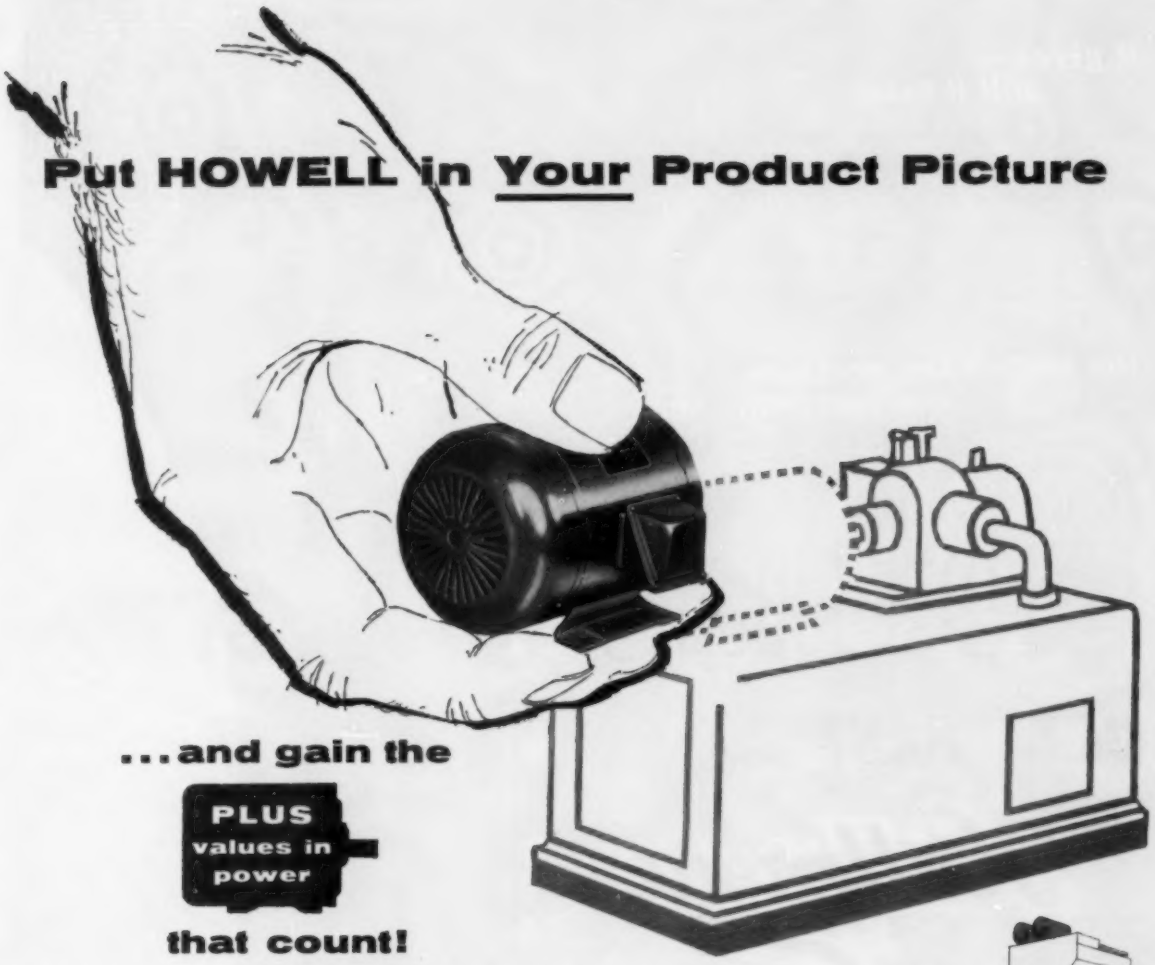
Pneumatic cylinders, operating on 20 to 45-psi air line pressure, provide the power for this dual jaw unloader. Developed by Press Automation Systems, Inc., Centerline, Mich., the carriages are advanced and retracted by a reversible air motor operating through a roller chain drive.

Hydraulic Press with Precise Pressure Control . . .

. . . for molding rubber and plastics is capable of hydraulic pressure to 75 tons capacity. A new hydraulic pump allows constant

Continued on page 48

Put HOWELL in Your Product Picture



...and gain the

PLUS values in power

that count!

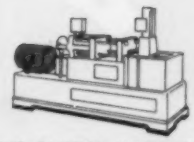
No matter how efficiently designed your hydraulic equipment may be, in operation its dependability rests . . . year in and year out . . . on the motors you select to power it. That's why manufacturers and users of hydraulic machinery, from simple pumps to the largest presses, are specifying Howell motors in ever increasing numbers. Here are a few of the reasons:

EXTRA DEPENDABILITY that challenges the years. Howell's new principle of heat-source ventilation . . . double sealed bearings . . . tough rolled steel frames and precision fitted cast iron end plates . . . these and many more are plus values that *count!*

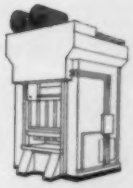
AN UNSURPASSED REPUTATION for engineering excellence and quality manufacture . . . built up by Howell in over 40 years of serving industry's motor requirements.

TOPS IN APPEARANCE. No other industrial motors have such smooth, unbroken contours . . . without an external fin or rib to mar their looks or catch dust deposits.

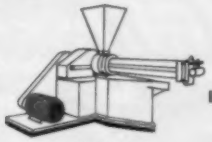
Howell makes virtually every type of AC industrial motors . . . fractional and integral to 300 hp, in all standard enclosures, in both rerated and non-rerated frame sizes, and in many pump mountings. Howell part winding motors, for economical reduced voltage starting of pumps may be of special interest to you.



DIE CASTING MACHINES

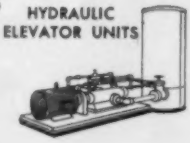


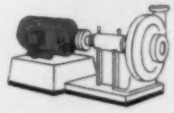
HYDRAULIC PRESSES



EXTRUDERS

HYDRAULIC ELEVATOR UNITS





FLUID TRANSMISSION PUMPS

Howell motors are specified and used by these leading manufacturers of hydraulic equipment:

The Denison Engineering Co. • Hydraulic Press Manufacturing Co. • Rotary Lift Co. • Globe Hoist Co. • Century Hydraulics, Inc. Haughton Elevator Co. • Michigan Drill Head Co.

A Howell sales engineer can give you valuable assistance on any motor application. Wire or 'phone collect . . . or drop us a line . . . you'll get prompt action. Howell Electric Motors Co., Howell, Michigan.

HOWELL *motors*

. . . precision built for industry since 1915

it gives—
and it takes

the higher the pressure—
the better the seal

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the seals that pressure can't lick

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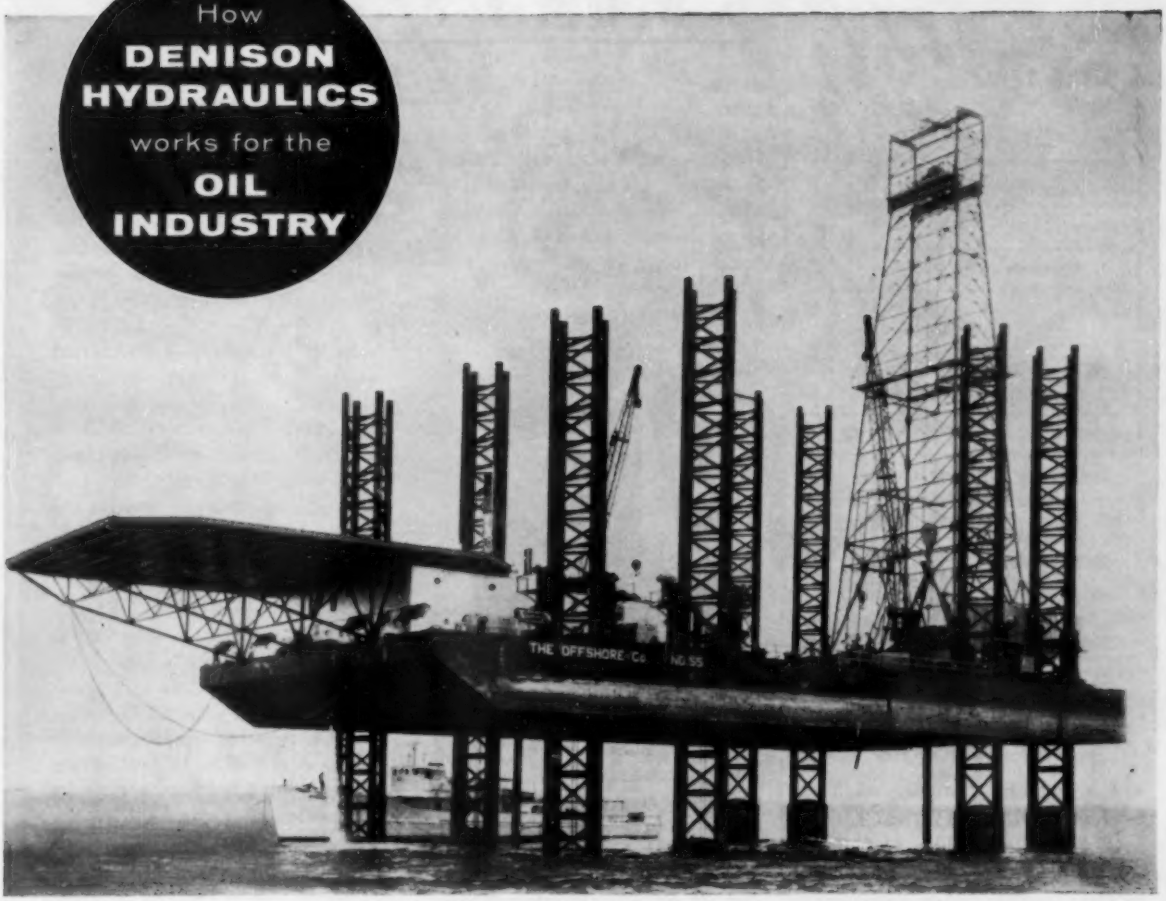
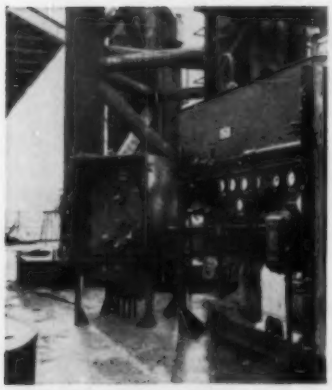
How
DENISON HYDRAULICS
works for the
OIL INDUSTRY



Lifts 6000 tons out of the sea with
DENISON HYDRAULIC PUMPS



***Actuating System Controls** for raising and lowering heavy off-shore rigs built by DeLong Corporation, New York. Denison axial piston pumps actuate hydraulic jacking cylinders, separately or in unison.*

When The Offshore Company faces the problem of raising its 6000-ton DeLong drill barges, they rely on Denison axial piston pumps to deliver the necessary muscle. Rated at 5000 psi continuous duty, four Denison pumps lift the 6000-ton platform at rates up to 15 feet per hour . . . with precision control from one central source.

Utilizing a Series 800, 35 gpm Denison pump at each corner, the hydraulic system developed by DeLong and built to specifications by Denison is capable of actuating lifting jack cylinders separately or in concert as needed. The result is close regulation of the massive 6000-ton load through a system of 16 individual hydraulic jacks on 8 caissons or towers.

Whatever your actuating problem, Denison can help you develop an efficient hydraulic system to do the job dependably and at low cost. Why not consult Denison on your next job. No obligation. Write us. Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

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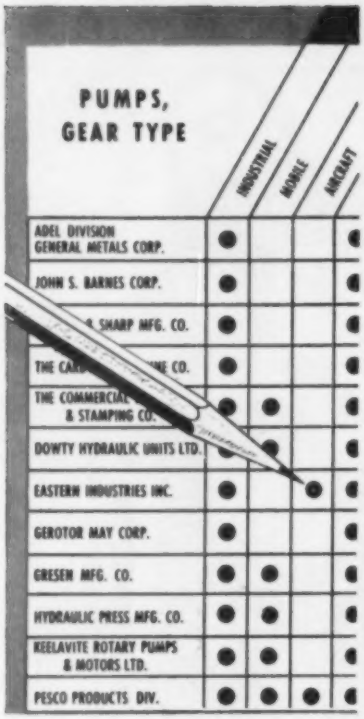
HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS



Quick with the answers . . .

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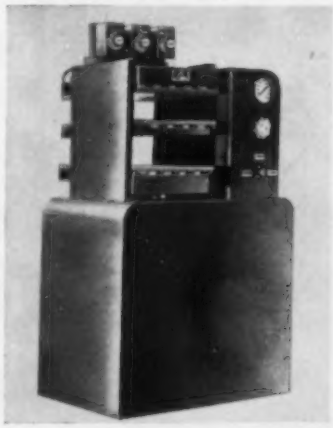
BRIEFS continued

pressure on the electrically heated platen area for any length of time without personal attention. The press, manufactured by Atlas Hydraulics, Inc., takes its power from



a 100 pound air line which drives a 4500 psi booster pump. When a preset pressure is reached, the pump will stop, and automatically operate only when required to maintain the pressure. The pump, oil reservoir, filter, pressure gage and all controls are integral parts of the press. ▼▼▼

Recent Publications

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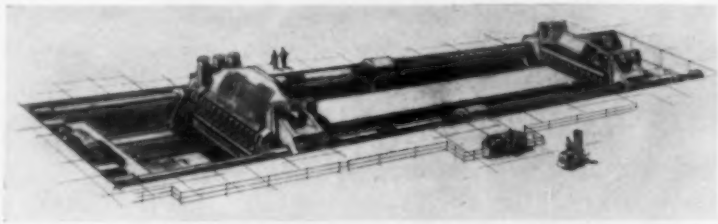
Continued on page 50

Hydro-Pneumatic Jaw Provides Safety Feature



On this 30-million-pound plate stretcher designed by Kaiser Aluminum & Chemical Corp., the gripping jaw mechanism includes a hydro-pneumatic system, similar to the recoil mechanism of a heavy cannon, capable of absorbing over 15-million ft lbs of energy in each head. A broken plate moving back into the jaws will be released by wedging action, and the plate will fly free through the open back of the head and hit an outside bumper to absorbe its energy.

This machine does not use a guiding frame and is free to move on tracks in the foundation. 42-in. dia. working colums are actually two columns in one, each 35 ft long, separated by a large stretching cylinder operating at 6000 psi. One of the columns is solid and the other is hollow to act as a manipulating cylinder. ▼▼▼

THIS AIR CYLINDER ACTS 78 MILLISECONDS FASTER

Take a 2½" bore conventional air cylinder, connect it to a remote valve with 6 feet of ⅜" diameter hose. *123 milliseconds* after the valve is operated, the air cylinder's piston begins to move.

Now take a Bellows Air Motor (the air cylinder with the *built-in* valve) of the same bore. The response time for the Bellows Air Motor is *45 milliseconds* . . . only 27% of the time required by the remote-controlled air cylinder.

Multiply that time-saving over an eight-hour shift . . . using, say, a six-parts-per-minute operation . . . and you receive 44 more parts each shift from your machine when you use a Bellows Air Motor with the built-in valve.

"Forty-four more parts each shift?" Not many, perhaps. But the multipliers . . . number of machines, number of shifts, length of production run, any one or all of them . . . can send the "44" up into respectability very quickly. In fact, it can mean 33,000 more parts per year from a single machine.

Quick response is only one of many advantages integral valving offers the user of air cylinders. Positive speed control; uniform power thrust; less air consumption; no cumbersome piping . . . all of these make an impressive total of cost saving advantages.

GET THE FULL STORY — Write for Bulletin BM-25. Twenty pages of helpful data every production man can use in his battle for lower costs. Address Dept. AH-1157 The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario.

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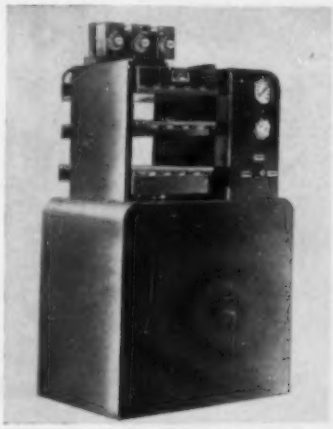

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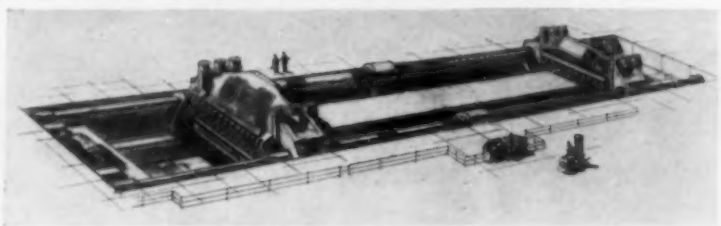

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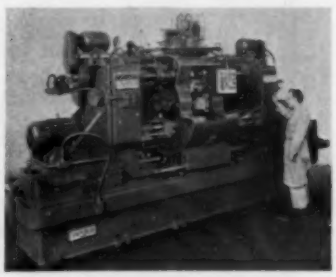
BRIEFS continued

kinematics, mechanism, dynamics of machinery, and design of machine elements. Major emphasis is on what can be done, what principles are involved, and where to find additional information required. ▼▼▼

Pneumatic operation of this parts cleaning machine, developed by Magnus Chemical Co., Inc., Garwood, N. J., provides fast operation with safety. Operation is entirely on compressed air, eliminating any electrical appliances or connections.

Hydraulics Permits Flexible Production

This electrically-controlled, trunnion-type machine has two standard, hydraulically-operated, way-type machining units mounted



on a welded steel base. The units slide on hardened and ground ways and are lubricated by a centralized automatic lubrication system.

The trunnion is indexed by a standard hydraulic-powered index mechanism. A separate motor-

Continued on page 52

NOW

for the first time

LOW COMPRESSION SET

Butyl "O" RINGS

NEW

Another LINEAR first . . . a new, low compression-set Butyl Compound for use in "O" Rings. LINEAR Butyl Compound 7806-70 is a seal material that withstands compression set at elevated temperatures without being permanently deformed or losing its resiliency and its value as a seal. Also, Butyl withstands the chemical actions of the non-flammable phosphate esters such as "Skydrol", "Pydraul", "Celluflex" and "Lindol".

YET, PROVEN

Exhaustive tests, under method "B" of the ASTM, show this new LINEAR compound develops only 30 to 40% compression set after 70 hours at 212°F, as compared to the usual 70 to 95% set experienced with previous Butyl compounds. This unusually good resistance to permanent deformation, combined with a tensile strength of 2000 psi and an elongation factor of 275%, make this material an outstanding one for all "O" Ring applications and other molded shapes where Butyl rubber's excellent qualities are desirable.

Whenever you have a seal problem that is tough to handle—look to LINEAR for an answer. Write, or ask the local representative for complete information on LINEAR's new Butyl Compound 7806-70—today.

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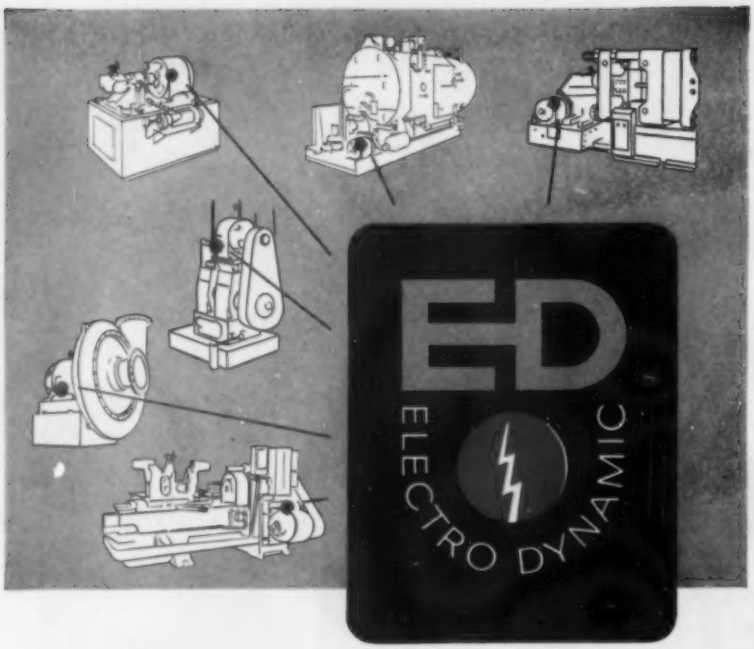
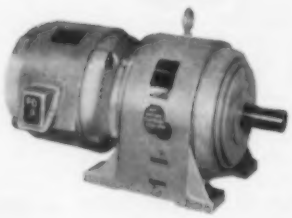
LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.



STANDARD MOTORS

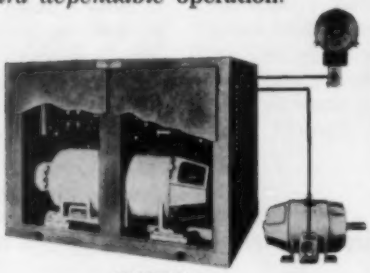
THIS EMBLEM IDENTIFIES EXTRA DEPENDABLE INDUSTRIAL MACHINERY



GEAR-ED-MOTORS

The red *power spot* on industrial machinery means "Powered by Electro Dynamic." Such machinery relies with confidence on the *extra dependability* of Electro Dynamic motors, the proven industrial motors which give industrial equipment *extra dependable* operation.

SELECTRON
VARIABLE-SPEED DRIVES



SELECTROL
VARIABLE-SPEED DRIVES

ELECTRO DYNAMIC
DIVISION OF GENERAL DYNAMICS
CORPORATION
BAYONNE, NEW JERSEY

BRIEFS continued

ized pump and tank unit provides hydraulic power for the machine. Synder Tool & Engineering Co., Detroit, used hydraulics in designing this machine to secure compactness and fine control. ▼▼▼

Compact hydraulic power permits this hydraulically elevating tailgate, designed by the Heil Co. of Milwaukee, to handle 4000-pound loads with ease.

Hydraulics Assists Cameraman

A hydraulic cylinder opens and closes the hood on this mobile camera wagon. Power is provided by a hydraulic pump operated by the power take-off of the truck. The truck motor is started or

stopped when desired from the control panel inside the "box" or from the cab.

Two, double-acting hydraulic cylinders stabilize the entire unit, and operate individually to level the unit when necessary. This Mobile Kamera Wagon was designed and built by Hydraulics Unlimited Mfg. Co., Eaton, Colorado, to take heavy photographic equipment into the field. ▼▼▼

One's right... for you

You can be certain that the oil seal International Packings Corporation recommends is the right one for *your* particular application.

IPC designs and manufactures a wide range and variety of oil seals and each one, large or small, is backed up by the "custom approach" to sealing problems.

The superior performance of IPC oil seals in so many applications is a result of specialized engineering, custom compounding, precise manufacture and rigid inspections.

Let IPC assist you at the "planning stage" to assure you of outstanding quality and service . . . your IPC representative will be pleased to offer further information. Call him today.

...and IPC has it!

IPC

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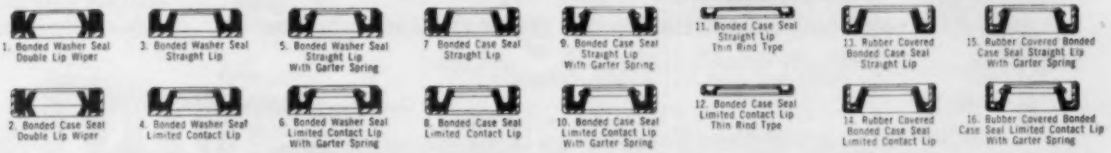

1. Bonded Washer Seal Double Lip Wiper
3. Bonded Washer Seal Straight Lip
5. Bonded Washer Seal Straight Lip With Garter Spring
7. Bonded Case Seal Straight Lip
9. Bonded Case Seal Straight Lip With Garter Spring
11. Bonded Case Seal Straight Lip Thin Rind Type
13. Rubber Covered Bonded Case Seal Straight Lip
15. Rubber Covered Bonded Case Seal Straight Lip With Garter Spring
2. Bonded Case Seal Double Lip Wiper
4. Bonded Washer Seal Limited Contact Lip
6. Bonded Washer Seal Limited Contact Lip With Garter Spring
8. Bonded Case Seal Limited Contact Lip
10. Bonded Case Seal Limited Contact Lip With Garter Spring
12. Bonded Case Seal Limited Contact Lip Thin Rind Type
14. Rubber Covered Bonded Case Seal Limited Contact Lip
16. Rubber Covered Bonded Case Seal Limited Contact Lip With Garter Spring

INTERNATIONAL PACKINGS CORPORATION
Bristol, New Hampshire

P6

PUROLATOR FILTERS FOR THE PROTECTION OF HYDRAULIC CIRCUITS

G-200M Aircraft Restrictor Filter two-way for hydraulic oil systems metal element

PR 361 ½ GPM line type hydraulic oil filter Micronic element

PR 362 3 CFM in-line vent type Micronic element

G 200 series in-line two-way restrictor filter Metal element, internal connections

PR 312 12 GPM line type filter Micronic element

PR 412-8 12 GPM line type filter Military approval

G-187 3 GPM in-line hydraulic oil filter Metal element

P 32-26 Low pressure, high flow hydraulic oil filter

Effective filtration is essential for optimum performance in hydraulic circuits. To keep a system clean and functioning properly, it is important that the filter be designed specifically to meet the requirements of the job.

Purolator's complete line of filters for hydraulic systems includes models for every set of operating conditions likely to be encountered. A few are shown here; there are many more standard models from which to choose. If your application requires a special filter, Purolator will design and build it. Let Purolator work on your toughest filtration problem.

Filtration For Every Known Fluid

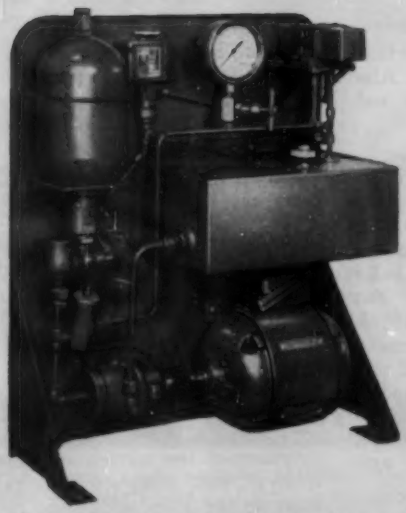
PUROLATOR

PRODUCTS, INC.

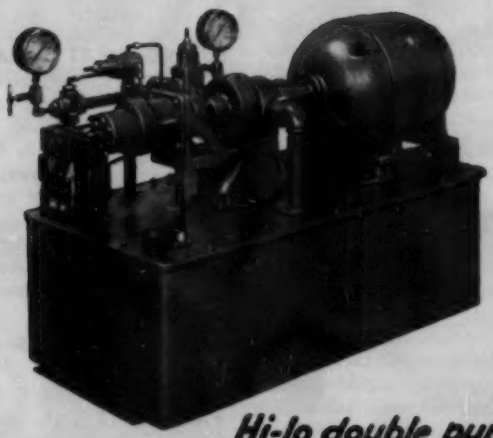
Rahway, New Jersey and Toronto, Ontario, Canada

WHICH POWER UNIT DO YOU NEED?

Standard?



Panel mounted package?



Hi-lo double pump?

RIVETT can supply the exact power unit to meet your requirements!

STANDARDS are available in 17 models at continuous working pressures up to 1000 P.S.I. and 1500 P.S.I. Single pumps are offered in six tank sizes. Capacities from .4 to 40 G.P.M. Double pumps are offered in four tank sizes with combined capacities from 3.5 to 80 G.P.M.

CUSTOM-BUILT POWER UNITS are offered for pressures up to 5000 P.S.I. They are designed to accommodate unusual requirements of space, size, piping, valving, mounting, or operation.

The better you know hydraulics — the better you like

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H. P. requirements, specifications, drawings fill this easy-to-use booklet. Write for free copy today!

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Dept. AH-11 Brighton 35, Boston, Mass.
Representatives In All Principal Cities

RIVETT furnishes a complete power package

AIR AND HYDRAULIC — VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

ELECTRO-HYDRAULIC SERVOMECHANISMS . . . manufactured by Pegasus Laboratories, Inc., Berkley, Mich., are illustrated and described in Technical Bulletin 100. Engineering information and technical data is given on electromechanical actuators, electro-hydraulic servo valves, instrumented hydraulic actuators and electronic equipment.

Circle 240 on Reader Service Card

STATIONARY AIR COMPRESSORS . . . manufactured by Le Roi Div., Westinghouse Air Brake Co., Milwaukee. Three new pieces of literature describe the entire line of Westinghouse unit type and Le Roi stationary air compressors. Features covered include lubrication systems, automatic protection, volumes and pressures, with brief specifications.

Circle 241 on Reader Service Card

PLUG VALVE OPERATORS . . . produced by Ledeen Mfg. Co., El Monte, Calif., are described and illustrated in Bulletin 3040. Units are designed for use in pneumatic or hydraulic service at pressures up to 200 psi. Bulletin gives details, including dimensions, weights and torque ratings.

Circle 242 on Reader Service Card

ELECTRIC MOTORS . . . offering the latest design of enclosure, and featuring more horsepower in less space, are illustrated and described in bulletin published by Sterling Electric Motors, Los Angeles. Folder gives complete details and specifications on enclosures available, including drip-proof, totally enclosed fan-cooled, vertical flange-mounted drip-proof. Also covered are explosion proof and fractional horsepower motors.

Circle 243 on Reader Service Card

TUBING HEAT TREAT DATA . . . on the Croloy steel produced by Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa., is available in Bulletin ASL 289M. Engineers and designers interested in the design of high strength materials will find useful data on yield strength, tensile strength, elongation, reduction of area and Brinell hardness at various annealing temperatures.

Circle 244 on Reader Service Card

FASTENERS . . . produced by Standard Pressed Steel Co., Jenkintown, Pa., for a wide variety of production assembly and maintenance applications, are described in a four-page bulletin. Line includes Unbrako socket screw products, Flexloc self-locking nuts, Sel-Lok spring pins and Hallowell steel collars. Bulletin gives sizes, materials, finish and other specifications.

Circle 245 on Reader Service Card

AIR PROBLEMS HANDBOOK . . . is available from Van Products Co., Erie, Pa. Booklet gives 20-pages of information on compressed air problems and how to solve them, including moisture, oil, solids, use of filters, and requirements of the air system. Booklet is illustrated with cartoon drawings and diagrams, and includes charts of filter specifications, and air needs for cylinders.

Circle 246 on Reader Service Card

AIR VALVES . . . two and three-way poppet-type, are illustrated and described in Bulletin 54 issued by A. Schrader's Son, Div. of Scovill Mfg. Co., Inc., Brooklyn, N. Y. Units have 70-cfm air flow capacity. Bulletin also describes 2, 3 and 4-way valves with hand lockdown lever, button-operated 2-way, and 4-way valve with lockdown foot pedal.

Circle 247 on Reader Service Card

POWER PACKS . . . manufactured by Huck Mfg. Co., Detroit, are covered in Bulletin 8-425. Descriptions of two models available is given, with complete specifications on the units, which are designed to power two to four hydraulic pull tools.

Circle 248 on Reader Service Card

UTILITUBE BOOKLET . . . is offered by Aluminum Company of America, Pittsburgh. Material is Aluminum coiled tube made of an alloy and selected to provide low cost, easy workability and high fatigue strength. Convenient tables give tubing characteristics. Burst strength varies from 2550 psi in ¾-in. size to 7380 psi in ⅛-in. OD.

Circle 249 on Reader Service Card

DIRECTIONAL CONTROL VALVES . . . for hydraulic service are covered in Catalog File 1552, published by the Industrial Hydraulic Division of Parker Appliance Co., Cleveland, Ohio. Complete engineering information and specifications are given for 1, 2, 3, 4, and 6-spool models.

Circle 250 on Reader Service Card

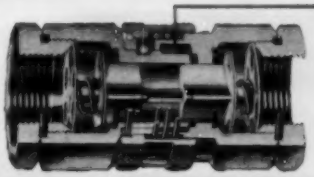
Continued on page 58

WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?

SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 12". Bulletin No. 240

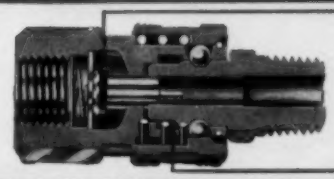


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines. Sizes: ⅛" thru ¾". Bulletin No. 230

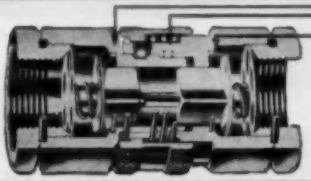


Bonded valve washer
(pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "HK" COUPLING . . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS, AND HIGH PRESSURE STEAM . . . "HK" is the only coupling now on the market for fluid temperatures from —100° F to +500° F . . . and for live steam up to 460° F. Its seals are made of Teflon for which there is no known solvent. Sizes: ½" thru 3". Bulletin No. 270



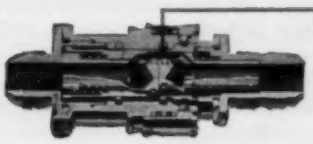
Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

SNAP-TITE NO-SPILL COUPLING . . . FOR MINIMUM AIR INCLUSION

FOR AIRCRAFT, MISSILE HYDRAULIC, FUEL SYSTEMS which cannot stand air in the lines, and for transmitting fluids which *must not spill*, the Snap-Tite no-spill coupling is recommended. Bulletin No. 280

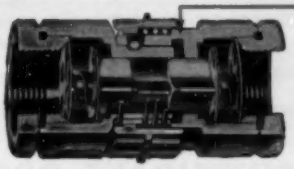


Flush valves prevent spillage, air inclusion. Snap-Tite will engineer special variations to your requirements.

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas. Sizes: ⅛" thru 12". Bulletin No. 250



Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 1, PA.

Snap-tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

Circle 126 on Reader Service Card

UCON
BRAND
HYDROLUBES

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

ECONOMY UCON hydrolubes 150-CP and 275-CP are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to UCON hydrolubes with a minimum of time and expense. UCON hydrolubes have no harmful effects on most packings or seals. In fact, in many instances, reduced leakage losses have been reported. UCON hydrolubes also provide maximum protection against liquid and vapor phase corrosion and have outstanding anti-wear characteristics—thus, pump replacement costs are also held to a minimum.

Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

30 East 42nd Street, New York 17, N. Y.

"Ucon" is a registered trade-mark of UCC.

Useful Literature / continued

STEPLESS SPEED REDUCER . . . with swash plate angle adjustable on both the pump and the motor ends, is described in a bulletin available from The David Brown Corp. (Sales) Ltd, Huddersfield, England. Complete description is given of unit's features, including speed adjustment by hand wheel or remote control, fan controlled air stream cooling, and completely contained oil circulating system.

Circle 251 on Reader Service Card

PRESSURE ANALYZER . . . manufactured by Aeroquip Corp., Jackson, Mich., is an electronic analyzer utilizing oscilloscopic principles to measure pressure activity and phenomena in the operation of hydraulic systems. Bulletin IEB 24 gives technical data and useful information on the Hydrauliscope. Units are particularly applicable for trouble-shooting hydraulic problems on new products, making accurate checks on efficiency, determining smoothness of hydraulic pressure, and detecting any undesirable shock or surge in the circuit. Unit is designed for use even by persons not familiar with electronic devices.

Circle 252 on Reader Service Card

FLEXIBLE COUPLINGS . . . Book 2775 details pertinent application and selection data for couplings with maximum bores ranging up to 7-in. and ratings from 2½ to 572 hp per 100 rpm. Available from Link-Belt Co., Chicago, booklet gives complete specifications and engineering information on their complete line of geared flexible couplings.

Circle 253 on Reader Service Card

AIR & OIL CYLINDERS . . . produced by Petch Mfg. Co., Alpena, Mich., are illustrated and described in Catalog No. 7A. Information and engineering specifications are given for five types of cylinders for air and hydraulic service, low pressure and high pressure types, sizes 1-in. to 10-in. Special cylinders can be up to 16 in. bore.

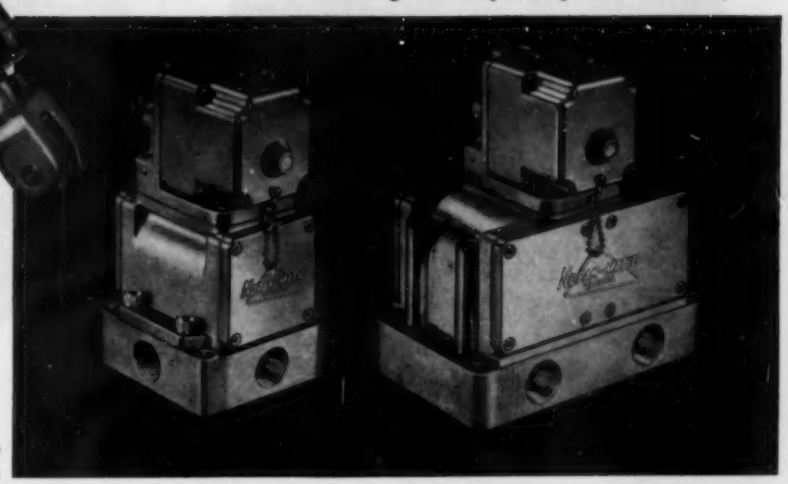
Circle 254 on Reader Service Card

For more reviews of FREE LITERATURE turn to page 174

New NOPAK *Team*

delivers PLUS VALUES in Air Power!

NOPAK Air Cylinders, long known for their dependability and economy, now can be applied to even greater advantage with the new Nopak-matic pilot operated air control valves. Full flow design and dependable performance make NOPAK Cylinders and Nopak-matic control valves the perfect "team" for "in plant" or O.E.M. applications. They deliver Plus Values that you can measure in terms of greater speed, higher efficiency, easier maintenance, a wider range of adaptability and versatility.



• NOPAK Class 1 and 2 Cylinders are available in 7 standard mountings in bore sizes from 1½" to 14" with a choice of non-cushioned, self-regulating or adjustable cushioned heads on all models.

• Nopak-matic, Pilot-operated, Poppet-type Air Control Valves are available in ¼", ⅜", ½" and ¾" pipe sizes for 2- or 3-Way normally open or normally closed operation, and 4-Way operation with master (air), single or double solenoid control heads. All 4-Way valves available, as standard, with choice of side or bottom ported sub-plates. Air pressures to 150 p.s.i.

Catalog 101-A and Catalog 105 provide complete descriptive and engineering data.

Other NOPAK Products for your Fluid Power Needs

• **CLASS 3 CYLINDERS**—for pressures to 2000 p.s.i. Compact steel plate square head and tie-rod construction. Honed steel tubing. Heads may be cushioned or non-cushioned. Available in 14 standard mounting styles.

• **CLASS 4 CYLINDERS** — High Pressure Hydraulic — Heavy, honed steel tubing with lock-ring flange construction. For hydraulic (oil) service at line pressures to 3000 p.s.i. Choice of cushioned or non-cushioned heads. Available in 5 standard mounting styles.

• **CLASS M CYLINDERS** (Mill Type) Welded flange construction, with honed steel tubing, eliminates tie-rods. Recommended for all types of Heavy Duty air or hydraulic pressures up to 650 p.s.i. depending upon diameter.

The NOPAK line includes cylinders and valves for a wide range of fluid power application — and its precision control. In addition to standard air cylinders, there are heavy duty, mill-type cylinders, square head and lock-ring flange type hydraulic cylinders. The NOPAK Valve line includes the famous packless rotating disc valves in both hand and foot models, high pressure hydraulic valves, Flotrol speed control valves and reciprocating valves.

NOPAK 2- 3- AND 4-WAY HAND VALVES are used to control single or double-acting cylinders at air or hydraulic line pressures to 250 p.s.i. Precision lapped seal eliminates packing, prolongs valve life. Disc rotating at right angle to stream flow permits throttling action or immediate opening to full pipe area. Pipe sizes from ¼" to 2".

NOPAK 2- 3- AND 4-WAY FOOT VALVES incorporate all of the features of NOPAK hand operated disc-type valves including the lapped-disc design and packless construction. They are available in 3 types which are adaptable to a wide variety of control needs. Pipe sizes from ¼" to 1" for pressures to 125 p.s.i.

NOPAK FLOTROL SPEED CONTROL VALVES provide uniform control of cylinder speed in one direction, free flow in the other. Features: quick, easy, precision adjustment without tools; greater capacity; easy installation because of compact in-line design; fit in tight places; made of rust and corrosion proof materials. Pipe sizes from ¼" to 1".

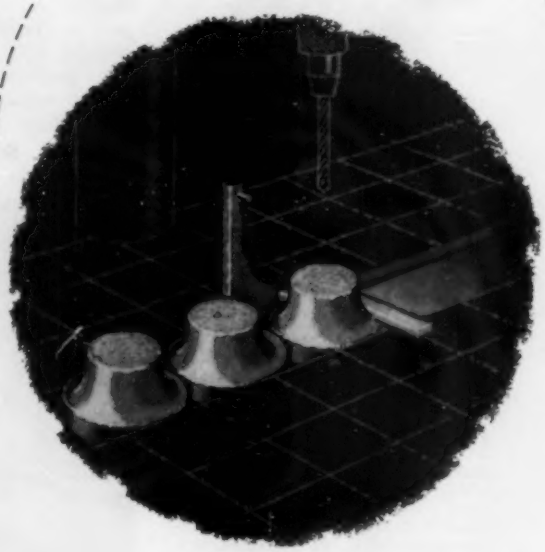
Write for Catalog SW-3

NOPAK *VALVES and CYLINDERS*

GALLAND-HENNING NOPAK DIVISION • 2743 South 31st St. • Milwaukee 46, Wis.

A7-618-1P

POSITION



Control them all with WESTINGHOUSE

If you want to position a workpiece precisely . . . if you want to hold it securely while drilling, machining, or forming . . . if you want to move that piece quickly on its way to the next operation . . . then, take advantage of the simplicity, the economy, and the reliability of Westinghouse Pneumatic Control.

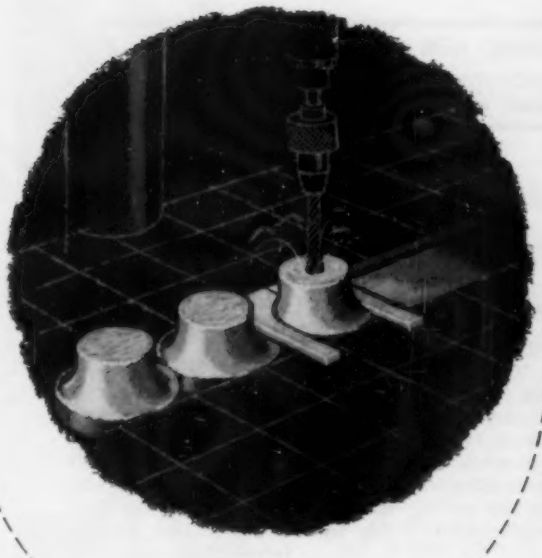
Today, Westinghouse Pneumatic Control can give you accurate remote control of modern assembly line machines or entire processes. It can give you precise interlocking and sequencing control. It also can help you to prevent human errors.

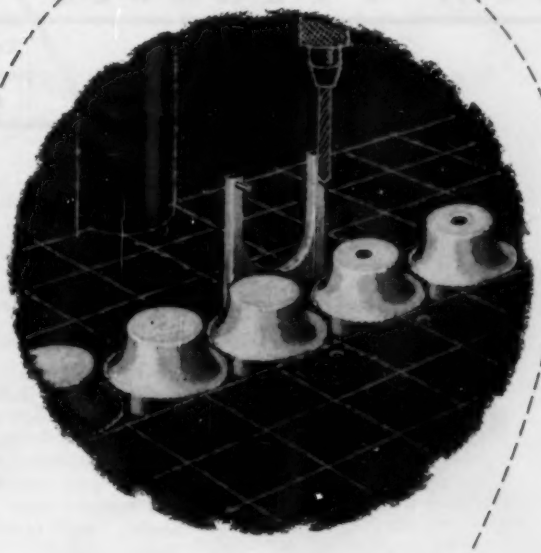
Best of all, Westinghouse specialists can help you with the application of pneumatic control to your operations. They bring you control engineering experience in a wide variety of industries—from control of assembly line manufacture to the operation of rugged earth moving equipment. You can get this helpful service throughout the world (overseas, from affiliated Westinghouse companies). Send the coupon for more information on modern uses for pneumatic control.

89 YEARS OF PNEUMATIC ENGINEERING EXPERIENCE

HOLD

MOVE





safely . . . simply . . .

PNEUMATIC CONTROL

Confidence—the world over

Westinghouse Air Brake
COMPANY
Industrial Products Division

WILMERDING PENNSYLVANIA

FREE PNEUMATIC CONTROL DATA—Here, in this new booklet, you will find basic fundamentals of pneumatic control engineering written clearly, concisely and with the authority of Westinghouse's 89 years of experience in this field. Send the coupon for a free copy. We'll also send you examples of recent applications of Westinghouse Pneumatic Control—applications which will show you the versatility of modern pneumatic control.

Westinghouse Air Brake Company
Industrial Products Division, Dept. AH-117
Wilmerding, Pennsylvania

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ADDRESS .....

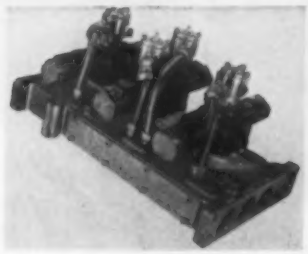
CITY ..... STATE .....

Circle 154 on Reader Service Card

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

MULTIPLE STATION MANIFOLD . . . provides group mounting

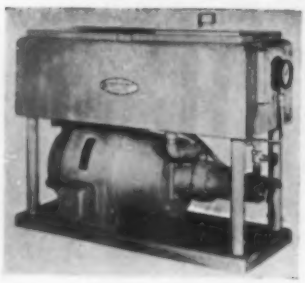


Features: Adaptable to any type of control valve application, the new manifold permits mounting of any combination of single or double-solenoid Speed King valves at any desired location on the manifold. Use of these manifolds cuts labor and material costs at machine assembly, and facilitates in-service maintenance.

Specifications: Manifold is cast aluminum, offered in two and three station types, with full length inlet and exhaust ports common to all valve stations. Conduit passage for wiring runs length of the manifold, with removable cover for easy access. To facilitate piping, manifolds are machined for both side and bottom cylinder porting.

Valvair Corp.
Akron, Ohio
Circle 170 on Reader Service Card

POWER UNIT . . . for 3000 and 6000 psi



Features: Designed to use direct-coupled electric motors with piston-type pumps, units may be modified to provide independent hydraulic power sources. Piston isolator valves enable the operator to use any or all of the pistons as independent power sources, up to ten on the larger pumps. In many instances entire piston assembly can be torn down without removing the unit from the line.

Specifications: Available in three tank sizes: 30, 50 and 80 gallons. With ratings of 2000-psi continuous, 3000-psi intermittent, at 2.5 and 4 gpm; 3000-psi continuous duty at 5.7 to 10.9 and 14.7 gpm, and 6000-psi continuous duty at 4.2 to 7.9 and 10.5 gpm, based on 1800-rpm motor.

Fornaciari Co.
Los Angeles, Calif.
Circle 171 on Reader Service Card

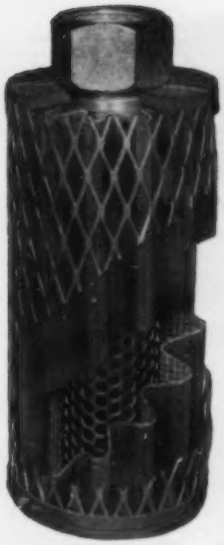
SOLENOID-PILOTED AIR VALVES . . . feature manual actuators

Designation: Model BVP

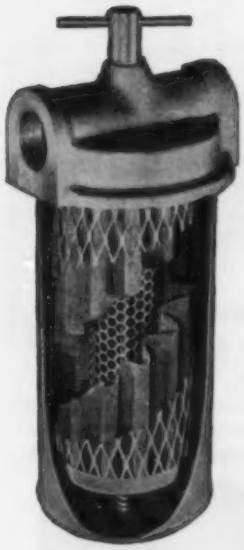
Features: Units are solenoid piloted air valves designed to permit control and operation of air cylinders without requiring the electrical system to be functioning. These are twist-type manual actuators and their use facilitates set up and try-out of the mechanism. Manual actuators are an optional feature.

Specifications: Model BVP-1 is the single-solenoid, and BVP-2, the double-solenoid valve. Both are full-pressure piloted and are available in ⅛ to ½-in. sizes for use with air. They feature high-speed operation, accurate control, and low current demand.

Beckett-Harcum Co.
Wilmington, Ohio
Circle 172 on Reader Service Card
Continued on page 64



SUMP TYPE
(cutaway)



LINE TYPE
(cutaway)

Here's What Users Have to Say About
MARVEL Synclinal FILTERS

U. S. STEEL CO., Irvin Works Three-Stand Cold Reduction Mill—

"Marvel Synclinal Filters are a part of the mill's main hydraulic system which operates Coil Cradle as well as other hydraulic machines".

JONES & LAUGHLIN STEEL CORP., Aliquippa Works—

"Marvel Synclinal Filters proved their effectiveness when one of the motors on the hydrostatic pipe testers broke down. A brass fitting was chewed up and jagged pieces of brass were carried into the oil stream. Any small piece of brass could also have caused a great deal of damage to the expensive equipment. However, when the unit was inspected, it was found that all metal particles had been filtered out by the Marvel Synclinal Filters and no damage had been done to the equipment nor was there any loss in operating time. Two filters are installed on each circuit so that one can serve as a by-pass while the other is being cleaned. Although it takes only about fifteen minutes to clean the monel filter insert, even this short interruption in production could be costly in an operation of this size".

P. R. MALLORY PLASTICS, INC. Supt. of Maintenance Leo Paszkiet reports—

"We have one injection molding press here that was giving me a lot of trouble. In order to maintain our 24-hour-a-day schedule, I had to stop it every two or three weeks to service the filters. It was a troublesome, time consuming job but it had to be done. Even then, the machine never seemed to reach the productive capacity I knew it was capable of. Well, I had enough of that so I pulled out the original 3 filters and replaced them with three 50 G.P.M Sump type, Marvel Synclinal Filters. That was over 10 months ago. During all this time the machine was operating faster and smoother than it ever had before. There was no more slow down of production due to pressure loss, vibration, pump starvation, etc. On the basis of these results, we are installing Marvels on every hydraulic machine in our plant, except of course, those on which Marvel Synclinal Filters were installed as standard equipment by the manufacturer".

Many others reporting similar results are now specifying MARVEL SYNCLINAL FILTERS on all new hydraulic equipment—and Standardizing with MARVEL SYNCLINAL FILTERS on all existing equipment.

For Dependable Protection on All Hydraulic and Other Low Pressure Circulating Systems— Investigate MARVEL SYNCLINAL FILTERS

They Meet J. I. C. Standards

FILTERS FOR ALL TYPES OF FIRE-RESISTANT FLUIDS

Marvel's most recent development is a filter for the efficient filtration of all types of fire-resistant fluids.

WATER FILTERS

Both sump and line type filters have been adapted for use in all water filtering applications. No changes have been made in the basic, balanced, synclinal design.

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation (as described in catalog). Choice of monel mesh sizes range from coarse 30 to fine 200.

OVER 800 Original Equipment Manufacturers Now Install MARVEL SYNCLINAL FILTERS as Standard Equipment!

IMMEDIATE DELIVERY!

Our catalogs contain complete engineering data and dimensional charts of all models and sizes. You can order a filter to meet your specific requirements and get IMMEDIATE DELIVERY.

Catalogs containing complete data available on request

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. **PHONE: Juniper 8-6023**

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- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name ..... Title .....

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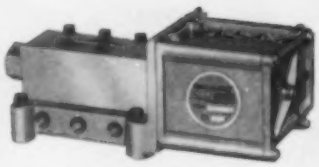
STOP!

Material Spoilage
Machine Damage
Operator Injuries
Breakdowns and
Plant Tie-ups

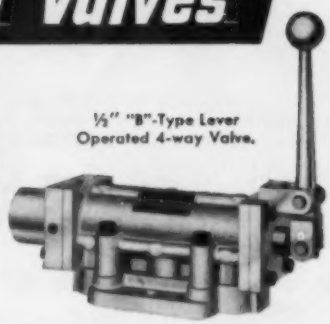
with

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



¼" "O"-Type Single Solenoid 4-way Valve.

½" "B"-Type Lever Operated 4-way Valve.



Play safe. Install Quick-As-Wink valves on **all** your air and hydraulic controls. Positive and fast acting, all operating parts are in pressure balance, avoiding any tendency to creep or crawl. You'll get month after month and year after year of long, dependable, trouble-free — **and safe** — service. There's nothing better than a Quick-As-Wink Control Valve. Can you afford to gamble with less? Sizes from ¼" to 4". Hand, foot, cam, pilot, diaphragm or solenoid operated. Thousands of different types, sizes and actions. Get full details.

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Quick-As-Wink®
AIR AND HYDRAULIC
Control Valves

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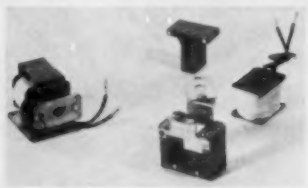
—Engineering and Sales Representatives in the Principal Cities—

New Products continued

SHORT STROKE SOLENOIDS
. . . are easily changed

Designation: Series S

Features: Designed to prevent tool down-time, coils may be changed in position in less than a minute, since no tools are needed. Uses no screws, locknuts, washers, plunger



guides or other parts which must be removed. Merely slipping the plunger out permits immediate replacement of the coil.

Specifications: Offered in 5 models giving 3 to 20 lbs force at ½-in. stroke, in push or pull types, with either end or side mounting plates. Features lower inrush current and reduced eddy current losses, resulting in colder cycling temperatures.

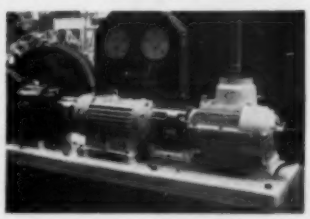
Ex-Cel Coil Co., Inc.
Detroit, Mich.

Circle 173 on Reader Service Card

SPEED REDUCER
. . . offers stepless operation

Designation: Varicon

Specifications: Motor-driven unit is coupled to a worm reducer. Input and output speeds are indi-



cated on separate dials. Input speed remains constant at 1500 rpm, but any output speed between 1500 rpm and zero can be smoothly and quickly obtained by means of the control knob.

David Brown Industries Ltd.
Huddersfield, England

Circle 174 on Reader Service Card

For more NEW PRODUCT reviews turn to page 157

Now... hydraulic assemblies made by a *hose* manufacturer

For the first time a world-known *hose manufacturer* offers a hydraulic hose *assembly* specifically engineered for every industrial need—construction equipment, farm machinery, machine tools, presses, lifts and other hydraulic equipment.

There are two important advantages in buying Gates Hydraulic Assemblies:

1. Gates is able to offer *over-all* quality control.
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Call your nearest Gates Engineering Office for help in solving hydraulic hose assembly problems. Quickly available stocks in all principal cities.

The Gates Rubber Company
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Gates High Pressure Hydraulic Hose (54MB) meets or exceeds SAE specifications

This smooth-covered, easy-to-keep-clean hose has reinforcing braid of extremely flexible high-tensile wire, made specially for this use. Black, oil-resistant rubber withstands heat, abrasion and weather exposure. Recommended for systems subjected to shock loads and heavy pulsating pressures.

Gates Medium Pressure Hydraulic Hose (19HB)

Same quality construction, but with braided cord reinforcement—more than adequate for the lower pressure applications.

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The Mark of *Specialized* Research

Gates Hydraulic Hose

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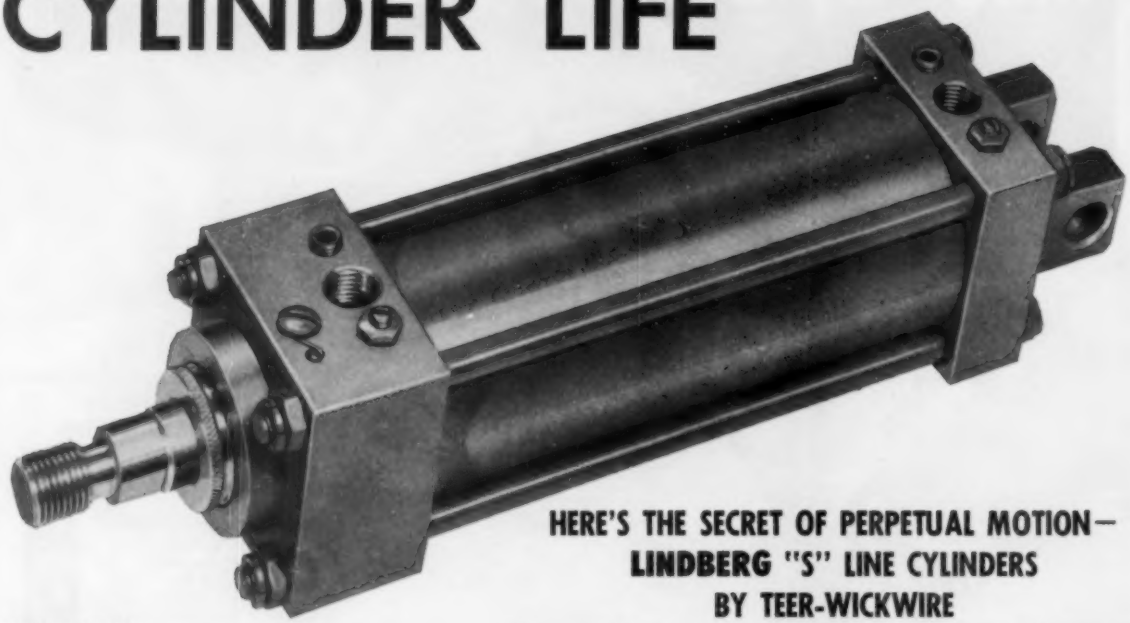
BUILT OF STEEL FOR LONGER CYLINDER LIFE



HERE'S THE SECRET OF PERPETUAL MOTION— LINDBERG "S" LINE CYLINDERS BY TEER-WICKWIRE

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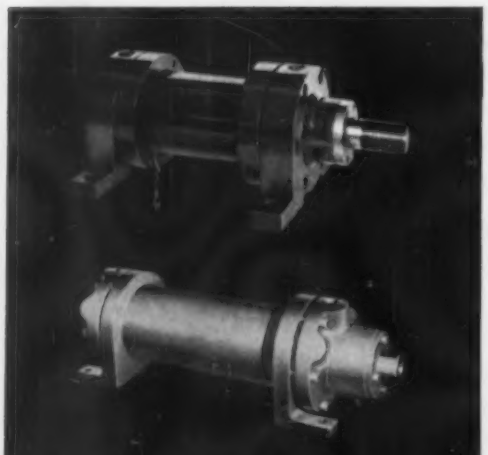

Ask about other **LINDBERG** Cylinders: Top—"H" Line, 2000 psi hydraulic (Bulletin H-101 • Bottom—"A" Line, air or low pressure hydraulic (Bulletin A-101) • Mill Type and other specials—write for details.

Of course, they won't run by themselves and we can't prove they'll run forever but many units, now in use, *have* run through millions of cycles and are still going strong.

HERE'S WHY!!

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- Chrome plated manganese steel Piston Rod—stronger—abrasion resistant.
- Steel Tie Rods—pre-stressed to carry equal load.

PLUS

- Change Packing, Wiper, Seal or Entire Rod Cartridge Assembly in minutes without special tools—exclusive quick change feature with Teer-Wickwire's **LINDBERG** "S" Line • Full floating cushions • Built to JIC recommendations.
- Mounting styles to fit your needs • 7 bore sizes to 6"—rated 250 psi pneumatic, to 1000 psi hydraulic • Standardized mounting dimensions • Write today for your copy of Bulletin S-101 for complete information on the "S" Line including these and 23 other soundly engineered features.

LINDBERG AIR and HYDRAULIC DIV.

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ERMETO®
HYDRAULIC TUBE FITTINGS

Weatherhead flareless Stainless Steel Ermeto tube fittings offer the greatest corrosion resistance presently available for standard hydraulic applications.

- Maximum high pressure seal
- Maximum corrosion resistance
- Maximum operating temperatures
- Maximum ease in installation

For many years Stainless Steel Ermeto fittings have been in the Weatherhead line. Complete warehouse stocks are available for immediate delivery . . . at your nearby Weatherhead Industrial Distributor.

WEATHERHEAD

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Test proves Texaco 100% effective against rust

Rust does more damage to hydraulic systems than any other factor. That's why the test results shown here are of vital importance to you. The steel rod on the left has been protected by *Texaco Regal Oil R & O,* the other one with ordinary oil. You can see which rusted, and how badly, and which did not rust at all. And it takes just one or two tiny flakes of rust to scratch precision-made pumps and valves, or clog orifices—bringing operation and production to a stop.

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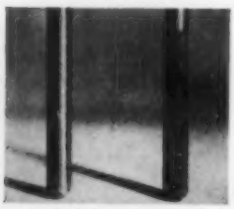
Ask a Texaco Lubrication Engineer to tell you how you can get a more dependable, efficient hydraulic system with *Texaco Regal Oil R & O.* Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.



AFTER 48 HOURS in ASTM* Rusting Test (agitating mixture of oil and 10% water, heated to 140°F) steel rod protected by *Texaco Regal Oil R&O* is 100% free of rust.

*American Society for Testing Materials

TEXACO

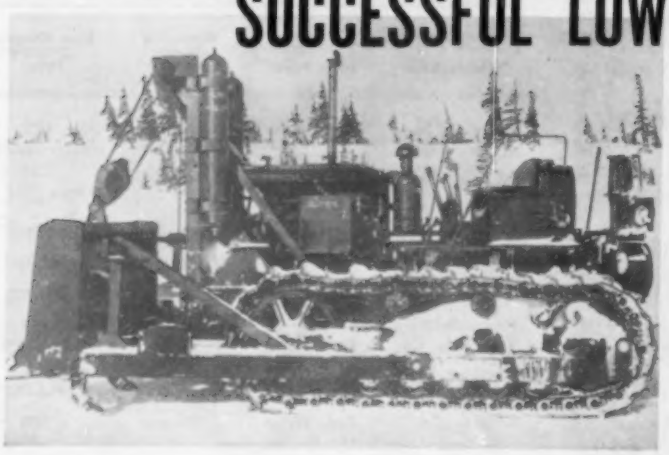
TEXACO Regal Oils R&O

FOR ALL HYDRAULIC UNITS

Satisfactory low-temperature hydraulic system operation is not difficult. However, certain common-sense precautions must be taken in component design, system design, and operation. Here are the steps for . . .

SUCCESSFUL LOW TEMPERATURE OPERATION

. . . of hydraulic systems



• By Keith A. Carlson,
Associate Editor

UNDERSTANDING the effects of low temperatures on fluids and elastomeric materials is the first step toward successful hydraulic system operation at low temperatures, Nearly all the differences between a successful low-temperature system and one for operation at normal temperatures result from changes in these two materials as temperatures drop.

• **Fluids**—As temperature drops, viscosity of both synthetic and petroleum base hydraulic fluids increases, Figure 1. Eventually a temperature is reached where the fluid congeals and will no longer flow or pour. This temperature is known as the Pour Point. Of course, a hydraulic system cannot operate if the fluid temperature is at the pour point or below. Therefore, fluid must be selected with a pour point at least 5 deg F below the minimum temperature at which it will be used.

Even though the fluid selected may have the required low pour point, certain viscosity requirements must also be met. In general, a viscosity range of 4000 to 70 SSU is considered acceptable

LOW TEMPERATURE OPERATION

for operation of hydraulic systems. One pump manufacturer states that starting up with oil viscosity of 20,000 SSU is permissable. However, a special starting procedure is required. The pump or system cannot run continuously at this viscosity without damage.

The acceptable operating viscosity range of 4000 to 70 SSU is the extreme range which can be tolerated. Actual recommended operating viscosities for the majority of hydraulic equipment rarely approach these values. Some typical recommendations are given in Table I.

Whether or not a fluid can meet the 4000 to 70 SSU recommendation is a function of the temperature range encountered and the viscosity index of the fluid. Viscosity index is a measure of the change in viscosity of a fluid as a result of a change in fluid temperature. The higher the viscosity index, the less the change in viscosity as temperature changes, Figure 2. Table II shows changes in viscosity of some typical fluids as well as their viscosity indexes.

There are fluids available which have high enough viscosity indexes to meet the 4000 to 70 SSU variation over a temperature range of —65 to 100 F. However, in certain applications, controlling viscosity by heating the oil may be preferable to simply charging the system with a high-viscosity-index fluid.

On the other hand, in a mobile application where fluid temperature due to intermittent operation and continued exposure to low ambient temperatures remained low, a high-viscosity-index, low-pour-point fluid would be mandatory.

• **Fluid Heating**—In industrial applications, accepted method for heating hydraulic fluid to reduce its viscosity is with electrical immersion heaters. These units consist of a helical coil of nickel-chromium resistance wire embedded in a refractory material and encased in a metal sheath, Fig. 3. These heaters are rated in kilowatts and are selected on the basis of 1 kw raising the temperature of 100 gal of fluid 10 degrees F in one hour. This is a good rule of thumb. For more exact determination, the following formula may be used.

$$kw = \frac{WsT}{3412\ t}$$

where: W = Weight of fluid, lb
s = Specific heat fluid, BTU/lb/deg F
T = Temperature rise, deg F
t = Time to heat, hr

Watt density or the amount of heat generated per sq. in. of heater surface is also an important consideration in heater selection. Too high a watt density will cause localized burning and carbonization of the fluid. Watt densities should be limited to 20 watts per sq. in. for circulating oil and 15 watts per sq. in. for non-circulating oil.

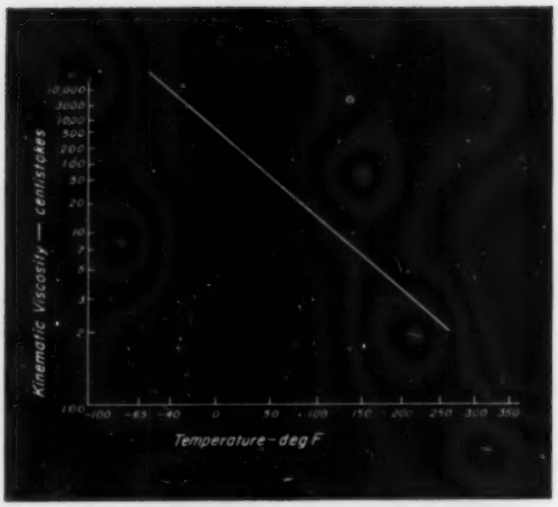


FIG. 1. A CHARACTERISTIC OF ALL HYDRAULIC FLUIDS which must be considered for successful low-temperature operation is increase in viscosity which accompanies decreasing temperature.

TABLE I—RECOMMENDED VISCOSITIES AND TEMPERATURES FOR TYPICAL PUMPS

Manufacturer	Pump Type	Operating Temp. (deg F)	Fluid Viscosity @ 100 F (SSU)
American Engineering Co.	Rad. Piston	100	525 (below 1500 psi) 1250 (above 1500 psi)
Brown & Sharp	Gear	———	250-300
Denison Eng. Co.	Ax. Piston	110-130	250-300
Gerotor May	Int. Gear	120-140	250-300
Hydraulic Press Mfg. Co.	Gear	———	950
	Rad. Piston	90-100	850-1000
Northern Pump Co.	Gear	———	300-500
	Ax. Piston	160 max	450-650
Oilgear Co.	Rad. Piston (to 60 hp)	160 max	300
	Rad. Piston (100 or 150 hp)	140 max	550
	Rad. Piston (to 10 hp)	170 max	550
Racine Hydraulics	Vane	160 max	200
Vickers Inc.	Vane	———	150-225 (to 1000 psi) 275-315 (over 1000 psi)
	Ax. Piston	———	275-315
Waterbury Tool Div.	Ax. Piston	150 max 120 pref.	320

This table is not intended to be complete or to supplant manufacturers' recommendations.

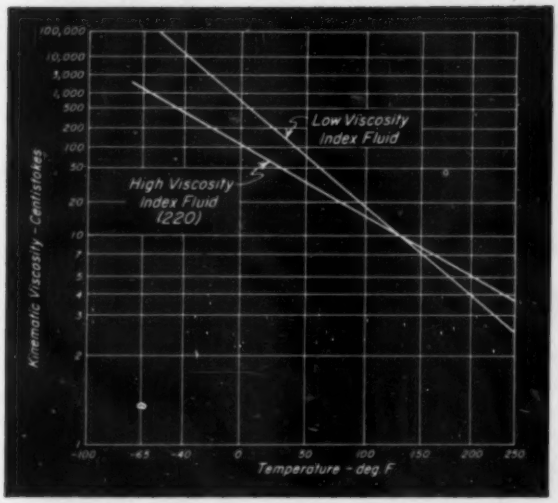


FIG. 2. VISCOSITY INDEX, is a measure of change in viscosity of a fluid with change in temperature. Viscosity characteristics shown are for high and low viscosity index fluids.

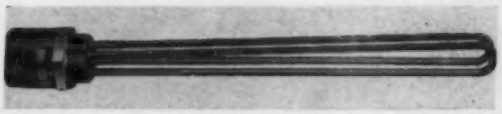


FIG. 3. TYPICAL ELECTRICAL immersion heater.

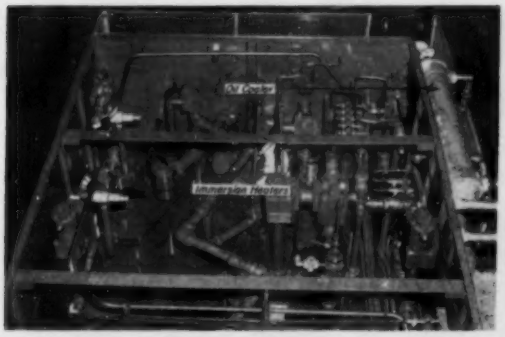


FIG. 4. IMMERSION HEATERS IN THIS TANK are mounted close to the bottom to promote convection circulation of heated oil in the tank. Enough space is left so sludge will not contact heaters.

TABLE II—VISCOSITY DATA FOR SOME TYPICAL HYDRAULIC FLUIDS

Manufacturer	Fluid Type and/or Designation	Pour Point (deg F)	Visc. @ 0 F (SSU)	Visc. @ 100 F (SSU)	Viscosity Index
Gulf Refining Co.	Series 340	+10	—	155	100
	Series 500	−30	—	156	52
E. F. Houghton & Co.	Houghto-Safe (water base)	—	8000	200	140
	Hydro-Drive MIH-20	—	21,000	300	—
Cities Service Oil Co.	Pacemaker I	−30	8000	155	95
	Koolmotor 5D 5W-20	−45	4000	160	147
Esso	Univis J-43 (MIL-O-5606)	−80	439	74	226
Std. Oil Co. (Ohio)	Sohivis 43	0	—	150	95
Monsanto Chemical Co.	Pydraul 600	+15	—	625	30
	Pydraul 150	−55	3000	145	170
Socony Mobil Oil Co. Inc.	Nyvac 20 (water base)	−35	3275	200	160
The Texas Co.	PC (R & O)	—	—	310	94
Pure Oil Co.	Puro-Pale RX Medium	−20	—	210	90
Sun Oil Co.	Sunvis 916	0	—	155	90
	Dynasol HD	−40	4000	180	150
Shell Oil Co.	Tellus No. 27	+10	—	150	90
	Aeroshell Fluid 1A (MIL-L-6085A)	−70	9200 @−40F	64	152

Higher values cause carbonization and premature breakdown of the oil as well as burnout of the heater.

Heater installation should follow certain rules for best results. Installation of heaters as close as possible to the bottom of the tank as shown in Fig. 4 will promote convection circulation. However, enough space must be left between the bottom of the tank and the heater to prevent sludge accumulations from contacting the units. This location also assures that heaters are completely submerged in the fluid preventing local carbonization.

Location of the heater or heaters with respect to the pump inlet is also important. A heater very close to the pump inlet may allow hot oil to be drawn into the pump and cause the pump to seize. On the other hand, locating heaters at quite a distance from the pump inlet, particularly in a large reservoir, may make heating very expensive and time consuming. These difficulties are avoided by placing a heater not closer to the pump inlet than 1 ft. and operating the pump on an intermittent schedule as soon as the oil has reached a temperature corresponding to the recommended maximum viscosity.

Thermostats must, of course, be installed to regulate heating. Correct location of thermostats is very important. They should be located fairly close to the heaters to prevent localized overheating. Recommended height is from 1/2 to 2/3 tank height. Thermostats should be adjusted to turn the heaters off as soon as the oil reaches a temperature of approximately 70 deg F.

• **Intermittent Starting**—When fluid temperature is such that viscosity is between 4000 and 20,000 SSU and the fluid is above the pour point,

TABLE III—MINIMUM TEMPERATURES FOR SEALING MATERIALS

Material	Recommended Minimum Temperature
Neoprene	−65[a]
GR-S	−65[a]
Buna N	−65[a]
Butyl	−80[a]
Thiokol	−100
Silicone	−100
Teflon	−300
Leather	−40
Cotton cloth—rubber	−40
Asbestos cloth—rubber	−40
Compressed asbestos	−300[b]

[a] With no mechanical or pressure movement.
[b] Gaskets only.

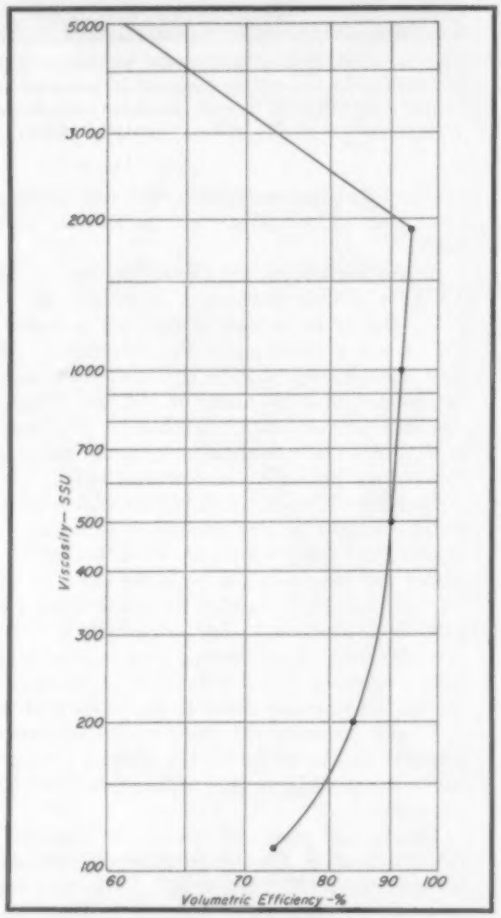


FIG. 5 VOLUMETRIC EFFICIENCY versus oil viscosity for a vane pump shows the very rapid decrease in volumetric efficiency accompanying cavitation as oil viscosity exceeds 2000 SSU. Inlet conditions for this test were far from ideal for pumping cold oil. A 90-deg. elbow was located only three inches from the pump inlet. Decrease in volumetric efficiency as oil viscosity decreases is the result of increased slippage.

an intermittent starting schedule may be followed according to one pump manufacturer. To avoid damage, this procedure must be very closely followed, particularly when viscosity is very close to 20,000 SSU. Procedure is:

1. Drive the pump for 5 sec. Stop! Allow to stand for 20 sec.
2. Repeat Step 1 ten times.
3. Drive the pump for 20 sec. Stop! Allow to stand for 20 sec.
4. Repeat Step 3 five times.
5. Run the unit continuously at light load until oil in entire system is warm.

If there are any signs of distress such as unusual noise during this procedure, additional operation at the preceding condition is indicated.

• **Elastomeric Materials**—Hydraulic system components in this category which require special consideration for successful operation at low temperatures are: packings, hose and bladders in accumulators. There are two reasons why low-temperature operation may require changes in these materials. First is the effect of low temperature alone on elastomers. The elasticity, so necessary for proper functioning, may be lost at low temperatures. Certain materials which are quite elastic at normal temperatures will become extremely hard and brittle at low temperatures. Materials are available for all conventional types of packings such as O-rings, U-rings, V-rings, etc. for operation at temperatures as low as −65 F, Table III. Below −65 F, fluoroplastics such as Teflon and Kel-F must usually be used and they must be spring loaded to compensate for low elastomeric properties. Hoses and accumulator bladders for temperatures to −65 are available, and suppliers should be checked to assure that these items are satisfactory for use at the lowest expected temperature.

Other factor in the selection of elastomeric materials for low temperature use is fluid compatibility. When special low-temperature fluids with high viscosity indexes and low pour points are used, suppliers of the fluid as well as manufacturers of packings, hose and accumulators should be consulted to determine whether or not fluid is compatible with the other materials in the system.

• **Condensation**—When hydraulic systems are started at low temperatures they usually operate over a wide temperature range. This promotes a much higher rate of condensation of atmospheric moisture than in systems maintained at relatively constant temperature. Therefore, fluids used at low temperatures should have antirust additives. Demulsifying agents may also be used in the fluid to accelerate the separation of water and fluid, so the water may be drained from a low point in the reservoir. Centrifuges, settling tanks and filters are also useful for removing excessive amounts of water from the hydraulic fluid.

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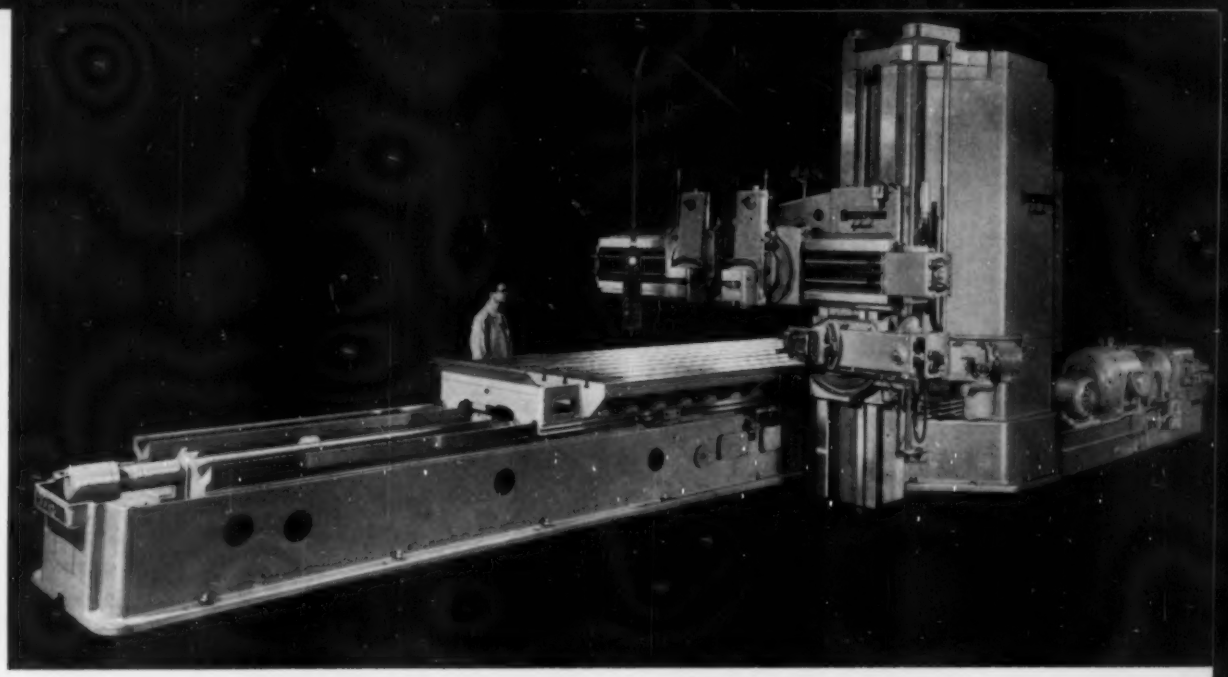

TRIPLE CIRCUIT

. . . for wide speed-force variation

● By Stanley Bjorklund

Chief Hydraulic Engineer,
Rockford Machine Tool Co.,
Rockford, Ill.

A unique circuit using a double-acting cylinder and a ram provides three distinct speed-force ranges for reciprocation of a planer table. To obtain the same maximum speed and force using a single cylinder would require a large increase in operating pressure or pump volume or both.

IN a hydraulic circuit using a variable-displacement pump and cylinder for operation over a range of speeds, available force from the cylinder is constant, at a value determined by the relief valve setting and piston area. Since horsepower is a product of speed, force and a constant, the horsepower characteristic of such a system is constantly increasing, Figure 1a. If horsepower requirement of the load matches or closely approximates this characteristic, that's fine. However, there are many instances where the load horsepower requirement may be relatively constant or even decrease with speed.

What is the significance of this as far as hydraulic system design is concerned? First, it indicates that pump drive motor selection should be based upon load power requirement rather than horsepower required to drive the pump at maximum rpm and peak pressure ratings. Load power requirement might never approach this value. In a planer or milling machine, for example, force requirement decreases as cutting speed increases for

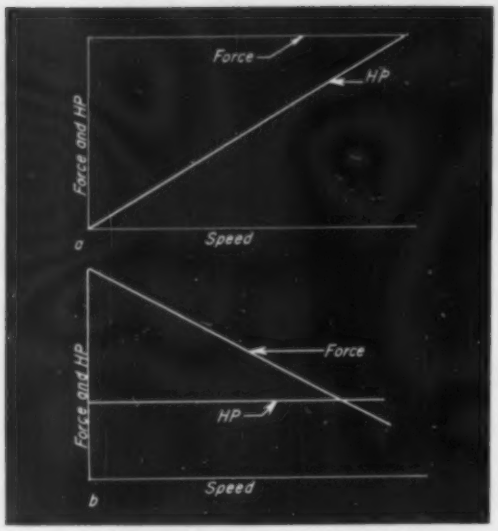

FIG. 1. FORCE AND HORSEPOWER VARIATION with speed in a hydraulic circuit using a single cylinder and a variable-displacement pump are shown at *a*. In many instances, the force and horsepower requirement of a machine may be more nearly like those shown at *b*.

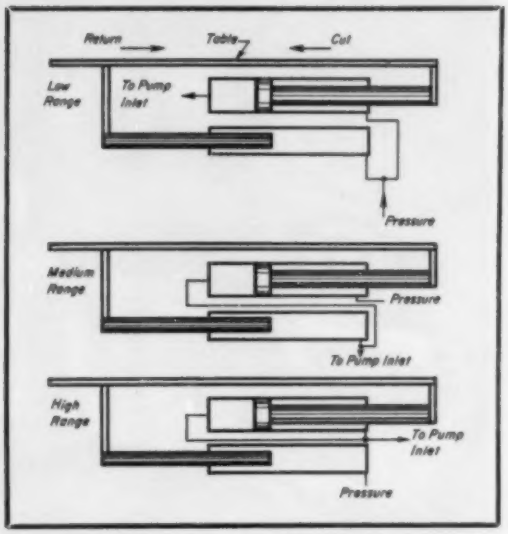

FIG. 2. DOUBLE-ACTING CYLINDER AND RAM may be connected as shown here to provide three speed and force ranges when used with a variable-displacement pump. This arrangement requires a smaller pump than a circuit using only a single cylinder.

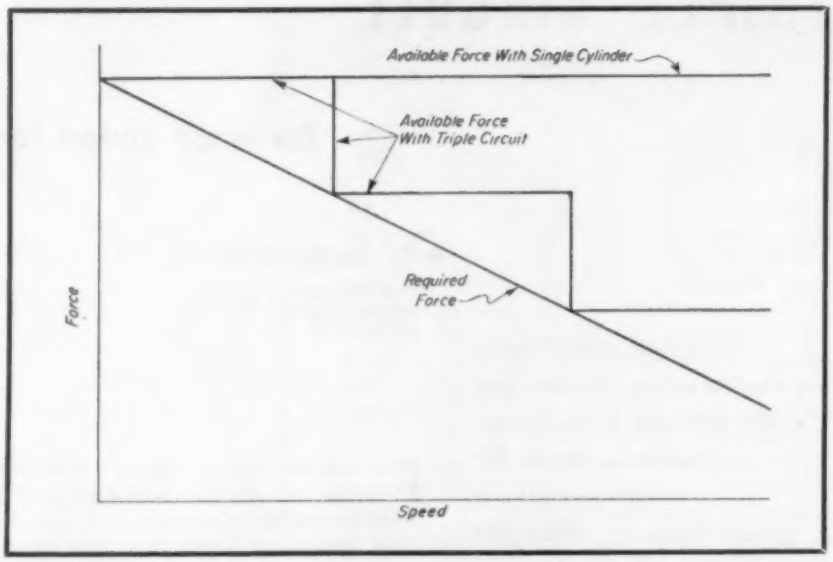

FIG. 3. COMPARISON OF THE SPEED-FORCE CHARACTERISTICS of the triple circuit, a single-cylinder circuit and actual machine requirements. Since pump capacity is the product of cylinder area and speed, force at maximum speed is proportional to the required pump capacity for a fixed pressure.

a given material. Load horsepower requirement for such an application is, therefore, almost constant, Figure 1*b*. This characteristic can be matched by a constant-displacement pump and a variable-displacement rotary motor. However, linear operation using a cylinder is wanted and there's no such thing as a continuously variable-area cylinder. If there were it would require a pump of considerably less output than a fixed area cylinder for the same speed range.

• **Triple Circuit**—A good first approximation to the non-existent variable-displacement cylinder is two cylinders of different areas which can be connected to give three different speed-force ranges. Figure 2. Figure 3 compares speed-force characteristics of the triple circuit, and a single-cylinder circuit with actual requirements.

Complete hydraulic circuit for a planer using this system is shown in Figure 4. Pump *A* is the main pump to supply oil to the double-acting cylinder and the ram for cutting and return strokes of the table. This pump is reversible and is used with the cylinders in a closed circuit. Pump *B* supplies fluid for operation of the main pump controls. A

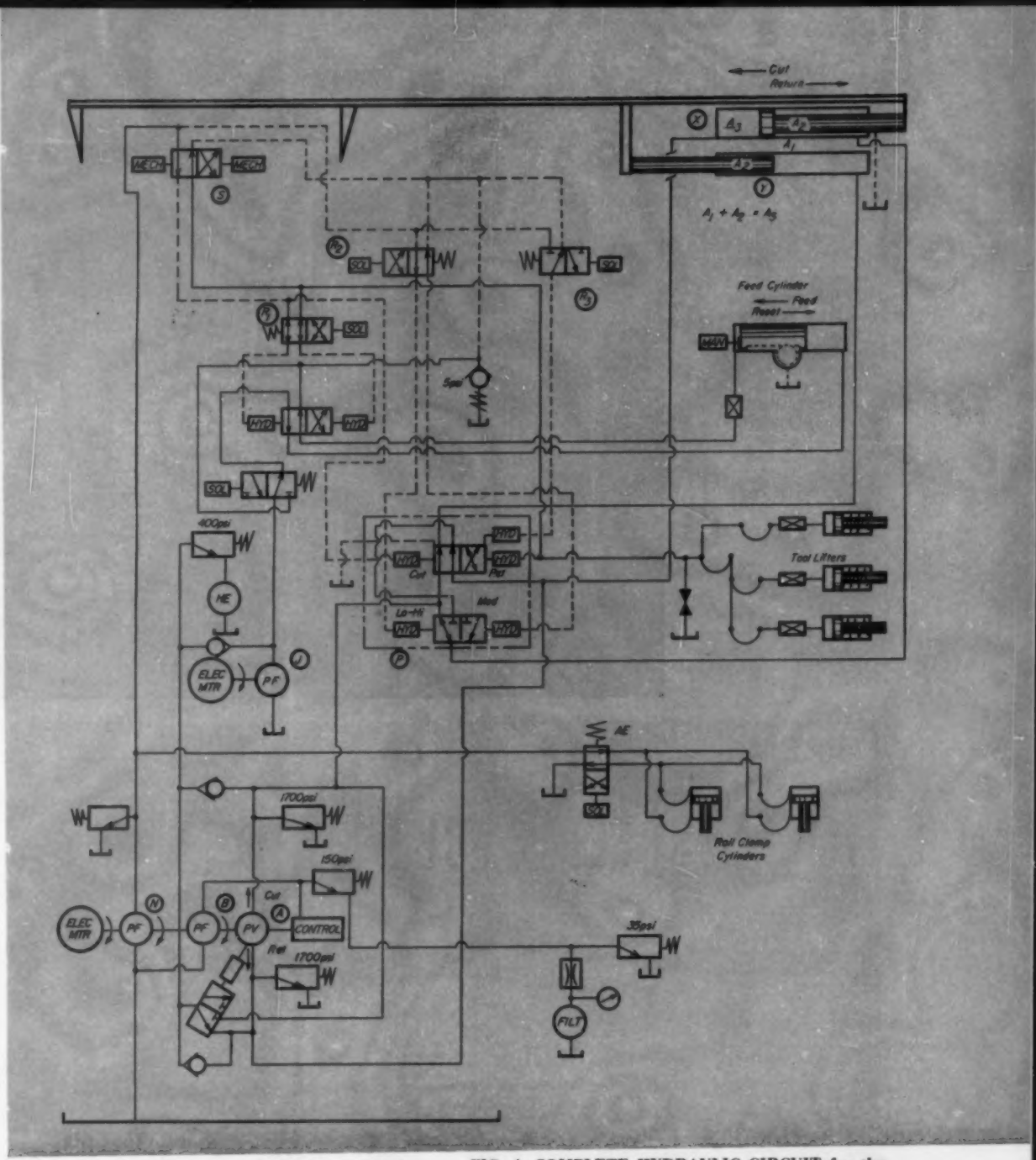

FIG. 4. COMPLETE HYDRAULIC CIRCUIT for the planer using the triple circuit.

portion of the output of pump *B* is continuously filtered and returned to the tank. Both pump *B* and pump *N* are integral parts of the main pump unit. Pump *N* supplies pilot oil for operating valves and also supplies oil to the rail clamp cylinders. Pump *J* is a separate pump driven by its own motor. It supplies supercharge and replenishing oil to the main pump circuit and oil for operation of the feed cylinder.

Sequence of circuit functions is as follows: When the variable pump is shifted to operating position, oil is delivered through valve *P* to the ram *Y* and to the rod end of cylinder *X* for cutting. At the end of the cutting stroke, valve *S* is shifted by an adjustable dog on the machine table to operate the tool lifters, reset the feed cylinder and shift the four-way of *P*. Reversal of pump flow by a linkage connected to *S* then causes high-speed return. Since the ram is connected to the pressure side of

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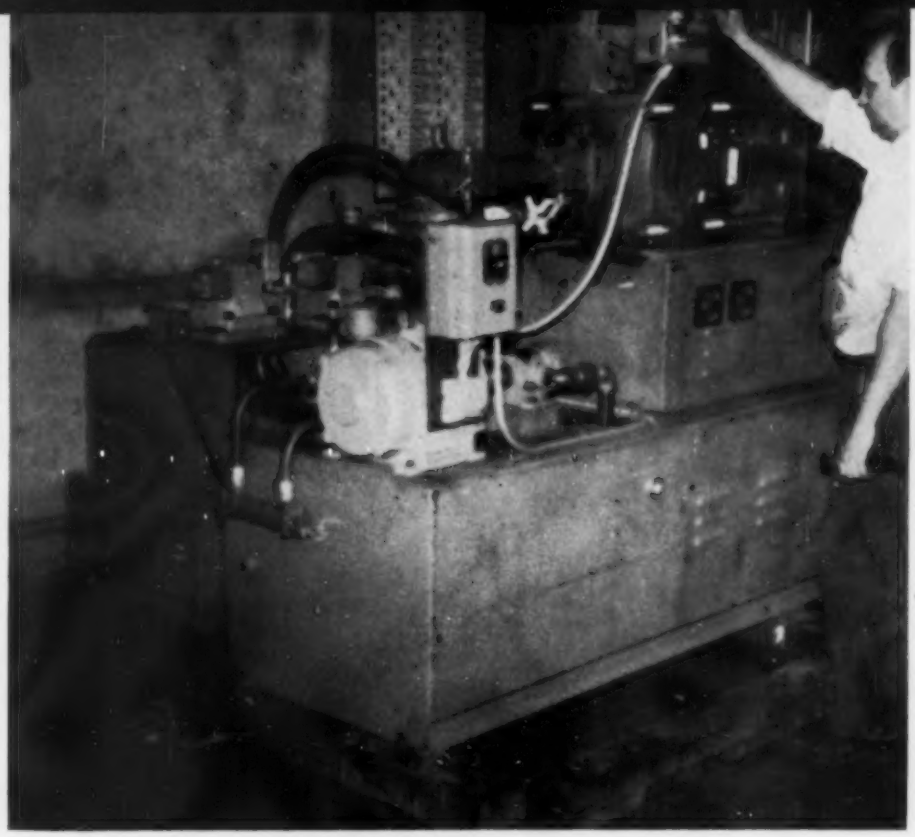

FIG. 1. ONE OF THE FASTEST DIE CASTING MACHINES of its type, this unit has a hydraulic system designed around two synchronous motor timers which control the automatic cycle. Machine is capable of producing 700 shots per hour weighing 3-lb. each.

TIMERS SPEED CYCLE

. . . of high speed die caster

● By S. R. Jaffe

President, American Die Casting Machinery Co., Chicago, Ill.

TWO timers which control the shot and die closing cylinders make the die casting machine manufactured by American Die Casting Machinery Co. one of the fastest of its kind, with a capacity of 700 shots per hour producing castings weighing up to 3 lb. The simplicity of the hydraulic system gives a low cost machine with an 80-ton locking force.

Synchronous motor timers control shot and chill time. A typical timing cycle is 1½ seconds for chill and 1 second for the shot time. Press closing and opening times are ½ second each, and total cycle is about 5 seconds.

The sequence valve is normally set at 1000 psi to insure a 4900-lb. force exerted by the die closing cylinder on the toggle linkage. The linkage then multiplies this to an 80-ton locking force on the dies. The sequence valve acts as a safety feature remaining closed at inlet pressures below its setting and preventing operation of the shot cylinder.

Connecting the relief valve in the line from the outlet of the sequence valve to the pilot-operated valve controlling the shot cylinder gives an accurate method of selecting pressure on the shot cylinder and also a means of providing overload protection. The relief valve is normally set for maximum pressures from 600 to 1000 psi.

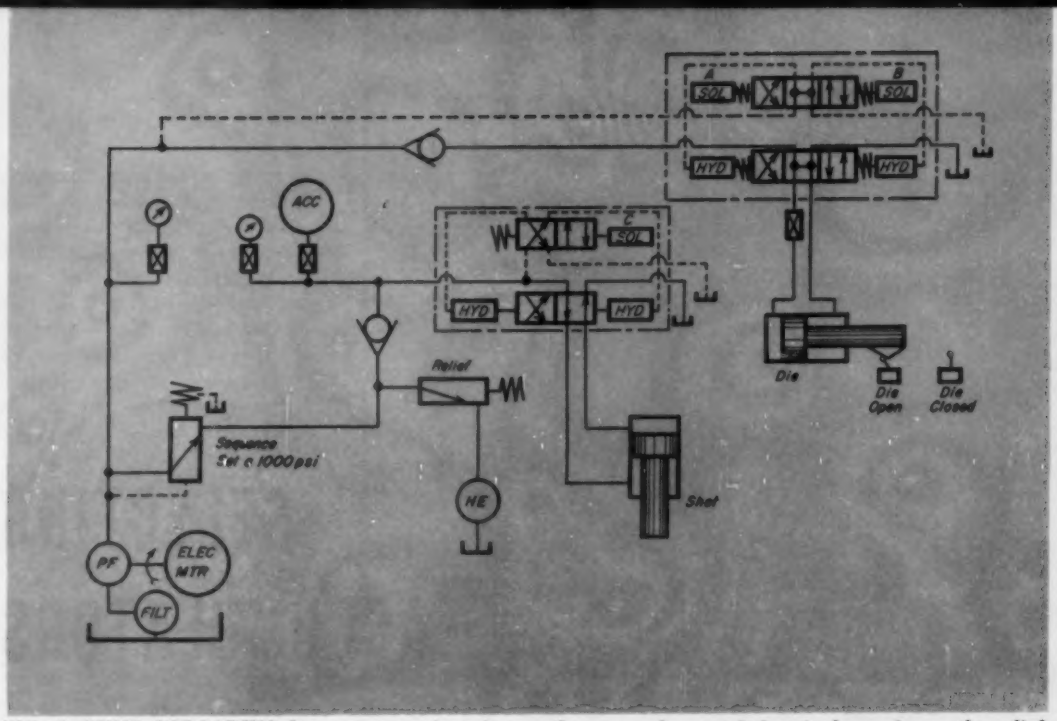

FIG. 2. PUMP UNLOADING between operations is through the neutral section of the 3-position valve. While the die is held closed and the shot cylinder is forward or back, pump delivery first recharges the accumulator and then is dumped over the relief valve. Heat exchanger is installed in relief valve drain line where fluid is hottest. Relief valve permits selection of pressure on shot cylinder.

FIG. 3. HYDRAULIC COMPONENTS of die casting machine include two solenoid-controlled, pilot-operated valves shown mounted on a shelf welded to the reservoir, and a 2½-gallon bag-type accumulator shown at left. Connections to the die closing cylinder are made through flexible hose.

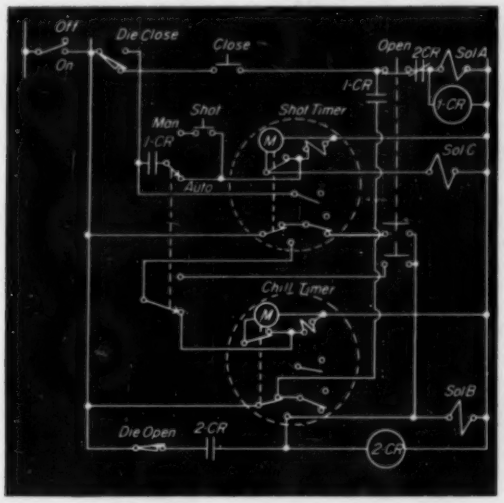

FIG. 4. ELECTRICAL CIRCUIT shows arrangement of timers. Shot timer is actuated when die is closed. When it times out, solenoid C is deactuated to return cylinder, and chill timer is started. When chill timer times out, dies are opened and circuit is reset for next cycle.

To speed the action of the shot cylinder, a 2½-gallon accumulator is connected to deliver to the cylinder on both extend and retract strokes.

In addition to the timers, sequencing is controlled by two limit switches which are actuated by cams on the die cylinder. The DIE CLOSE limit-switch is actuated when the die cylinder is completely extended and energizes the solenoid valve controlling the shot cylinder. The DIE OPEN limit-switch is actuated by the die cylinder just before the die is fully open to reset the circuit for the next cycle. ▼▼▼

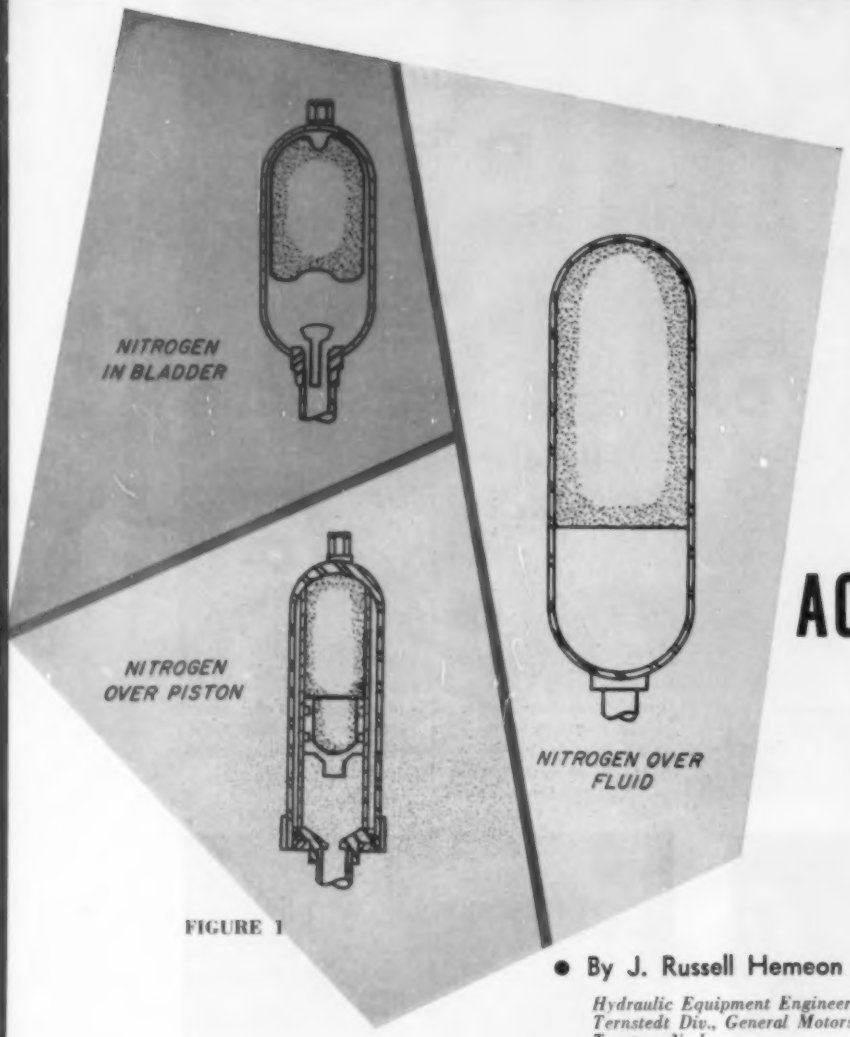

FIGURE 1

SELECTING ACCUMULATORS

. . . for minimum maintenance

• By J. Russell Hemeon

Hydraulic Equipment Engineer,
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Trenton, N. J.

Hydraulic accumulator performance can be improved and time between scheduled preventive maintenance periods increased by proper size selection based on experience. Specification of adequate or oversize accumulators may result in a slight cost increase. However, this is more than warranted by the increase in performance and less maintenance. This article presents a method and formulae for setting up preventive maintenance schedules based on actual experience.

FOR optimum accumulator performance, certain factors must receive careful attention:

1. Selection of the proper type and size accumulator.
2. Effects of operating temperature upon performance.
3. Correct sizing of associated valves and piping.
4. Accumulator life and maintenance periods.

• **Type Selection**—There are three major types of hydraulic accumulators, Figure 1. Each type has advantages and disadvantages which must be considered in design specification. In applications where there must be controlled tool closing and opening, and a cushion means for fast force reversal, the nitrogen-in-bladder type is usually preferred. Wipers on benders typify such a requirement. The nitrogen-over-fluid or open type is universally accepted for zinc die-casting operations where potential energy must be available for fast

acceleration. Nitrogen-over-piston accumulators provide high-speed fluid delivery with a powerful terminal impact factor. Machines used for piercing and coining illustrate this type of operation. Considerations upon which these recommendations are based include optimum maintenance periods as well as performance considerations.

• **Sizing**—Proper accumulator size, based upon experience, is determined from the formula:

$$G' = C'\Delta V \quad \text{.....(1)}$$

where G' = Total accumulator volume
C' = Calculation Constant
ΔV = Theoretical volume discharged by the accumulator during the working stroke

Calculation constant C′, to be used in Formula 1 is determined from

$$C' = A \times B \times J \times t \times S \quad \text{.....(2)}$$

where A = Ratio of fluid remaining in the accumulator after discharge to the amount discharged $= (V_1 - V_2)/\Delta V$

B = Ratio of fluid to gas volume after the working discharge $= V_1/(V_1 - V_2)$

J = Factor to compensate for extremely high flow rates during accumulator discharge

t = Temperature compensating factor = Temperature of oil in accumulator/100

S = Factor to compensate for speed of gas expansion

Table 1 contains values of all these factors to be used in accumulator calculations. In most instances, Table 1 contains three values of each of these quantities. Selection of the appropriate value from the table is based upon the degree of the designer's experience with the application, high, average or low. Certain of the values in Table 1, such as those for A and B, are based solely upon experience, and by their use an accumulator of the most economic size consistent with maintenance requirements is selected.

• **Service Life**—Third major consideration in accumulator selection is service or maintenance life. Experience has shown that these rings have halved the rate of oil leakage to the nitrogen side of the piston.

SIZING ACCUMULATORS FOR 3 MACHINES

To illustrate the application of these formulas here are sample calculations for three applications

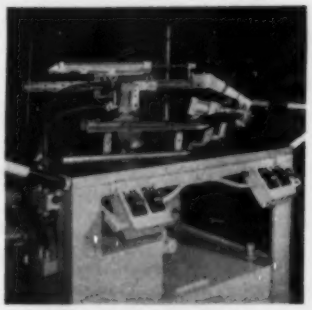
Value of V for a tube bender, is 4.66 cu in. Therefore, a bladder-type accumulator is selected with size

$$G' = 4.66 \times 3 \times 3 \times 1.25 \times 1.15 \times 1.05 = 63 \text{ cu in.}$$

Since this is a little more than one quart and the nearest standard size larger than the calculated value should be used, a one-gallon accumulator is selected. Economics are also involved here. A single 1-gal accumulator costs less than two 1-qt accumulators. Service life is then calculated using 450 psi for P_s. and 228 for V_1.

$$M' = \left(\frac{228}{4.66}\right)^{1.2} \times \frac{3 \times 10^7}{450^{1.2}} \times \frac{1}{\sqrt{1.51}} = 1{,}700{,}000 \text{ cycles}$$

Since the actual machine requirement is 1600 cycles/hr for a 12-hr day for 25 days per month, service period before recharging is required is a 3½ months.



A 1-GAL BLADDER-TYPE accumulator is used on the wiper circuit this bender for outside trim molding of automobile bodies. Torque capacity is 75,000 in.-lb.

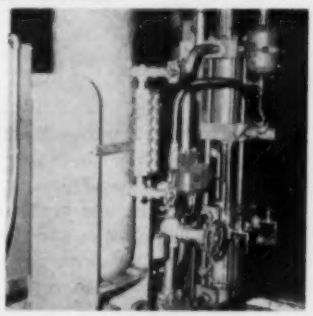
For a die-casting machine, with a computed discharge requirement of 115 cu in. or 0.5 gal, an open-type accumulator will be selected and

$$G' = 12 \times 3.1 \times 1.15 \times 1.05 \times 1.05 \times 0.5 = 23.5 \text{ gal}$$

Therefore, the nearest standard size, 28.8 gal is used. with $P_2 = 800$ psi and $N = 0.08$,

$$M' = \left(\frac{28.8}{0.5}\right)^{1.2} \frac{0.08 \times 10^7}{800^{1.2}\sqrt{1.27}} = 30{,}200 \text{ cycles}$$

Since the number of machine cycles per day for this machine is 4550, servicing period is 6-2/3 days. This is quite reasonable for this type of accumulator.



A 7-LB SHOT OF ZINC is supplied to this machine by a 28.8-gal accumulator. Since there is high rate of nitrogen absorption in the open-type accumulator used, accumulator capacity must be high to provide reasonable servicing intervals.

Selection of an accumulator for a high-speed piercing machine follows the same procedure. Of course, the accumulator should be the piston type as previously discussed to provide the necessary high inertia. Then for $V = 35$ cu in.

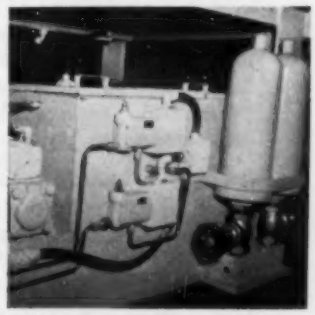
$$G' = 2.5 \times 2.5 \times 1.25 \times 1.2 \times 1.05 \times 35 = 350 \text{ cu in.}$$

In this application, it was decided to double the accumulator capacity and use two 350-cu-in. accumulators to increase servicing intervals. Then at $P_2 = 750$ psi,

$$M' = \left(\frac{700}{35}\right)^{1.2} \times \frac{8 \times 10^7}{750^{1.2}\sqrt{1.58}} = 822{,}000 \text{ cycles}$$

Since the number of machine operating cycles is 200,000 per month, service period is 4.1 months.

Pistons in these accumulators were changed from aluminum to steel to give even higher inertia for the piercing application. O-ring piston seals were replaced with a T-section ring to give better service



FOR HIGH INERTIA effects desirable on a piercing machine, piston-type accumulators are used. In this machine, the aluminum accumulator pistons were replaced with steel pistons to increase inertia effects.

life. Time between recharging periods in cycles, M′, is found from

$$M = \left(\frac{V}{\Delta V}\right)^{n} \frac{N \times 10^{7}}{(P_2)^{n}\sqrt{D}} \quad \ldots\ldots (3)$$

where N=3 for bladder type accumulators
=0.08 for open types
=8 for piston-type accumulators
n=1.2
P_2=Pressure at end of accumulator discharge
D=JSt

• **Some Explanations**—Calculations and recommendations given epresent quite a departure from the traditional method of accumulator selection using Boyle's Law. Why? First, Boyle's Law calculations assume isothermal expansion of the gas in the accumulator. In practice, this is not true. Expansion is mixed or polytropic with an exponent, n=1.3. This is because rapid expansion of the gas causes rapid cooling and an even further decrease in pressure.

Actual discharge required from the accumulator is also usually in error. Experiment has shown that actual discharge of oil from the tank port of a four-way valve controlling a cylinder may be as much as 2½ times as much as theoretical accumulator discharge on a fast discharge cycle. High velocity and inertia of the oil between the rod side of the piston and the tank will void a portion of this volume with the result that reversal of the four-way valve to return the piston requires that the accumulator provide this additional volume of oil to refill the voided portions of the circuit.

Can this condition be eliminated? Yes. At least in part. A spring-loaded check valve in the circuit at the point marked *X*, Figure 2, will choke off much of this loss. However, use of a spring strong enough to do this efficiently will produce complaints because of noise. Springs to produce back pressures in the range of 15 to 35 psi will usually produce a satisfactory compromise between noise and oil losses. Still, a third more oil than the theoretical accumulator discharge can be lost in this manner.

Factors in Table 1 labelled "high experience" assume that this precaution of the spring-loaded check valve will be employed. For satisfactory life without undue servicing, these recommendations should not be exceeded. ▼▼▼

TABLE 1—ACCUMULATOR SIZING FACTORS

	Exp. Factor	A	B	J	s	t	C	D
Bladder	Low	3	3	1.25	1.15	1.05	13.5	1.51
	Ave.	3	3	2	1.2	1.25	27	3.0
	High	3	3	2.5	1.5	1.35	45	5.06
Non-separator	Low	12	3.1	1.15	1.05	1.05	47	1.27
	Ave.	12	3.2	1.8	1.10	1.20	91	2.38
	High	12	3.3	2.2	1.15	1.30	133	3.29
Piston	Low	2.5	2.5	2.5	1.6	1.35	34	5.4
	Ave.	2.5	2.5	2.0	1.35	1.25	21	3.37
	High	2.5	2.5	1.25	1.2	1.05	10	1.58

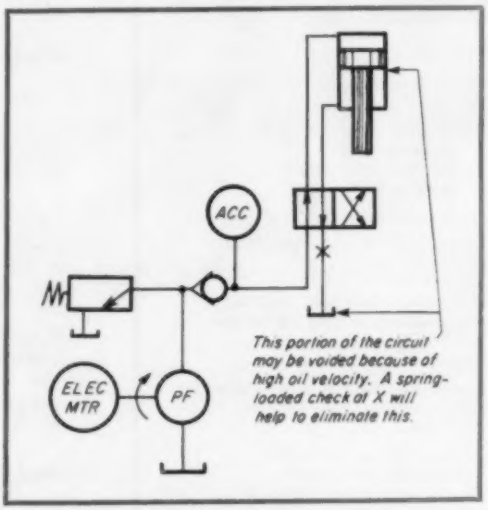

ACC
X
ELEC MTR
PF
This portion of the circuit may be voided because of high oil velocity. A spring-loaded check at X will help to eliminate this.

FIG. 2. Evacuation of the portion of the hydraulic circuit between the piston-rod side of the cylinder and the tank can increase accumulator demand by 250%. A spring-loaded check valve inserted at *X* will eliminate a great deal of this fluid evacuation.

This article is based on ASME Paper No. 56-SA-59, "Hydraulic Accumulator Applications," presented at a joint session of the Hydraulic and Machine Design Divisions at the Semi-Annual Meeting, Cleveland, O.—June 17-21, 1956.

Previous articles on accumulators published in APPLIED HYDRAULICS Magazine:

Design Considerations for "Stopping That Bounce". J. J. MELEAD. Mar 1955. Accumulator absorbs the shock of flying knife on an automatic plastic winder.

How to Prevent Hydraulic Shock on Mobile Equipment. L. DRASIN, W. STAMPFL. Oct 1954. Analysis of Accumulator Circuits on fork lift trucks.

3 Pressure Switch Controlled Accumulator Circuits. R. P. ESSER. June 1954. Circuits which automatically cut-in and cut-out pump delivery are described.

The Development of Cylindrical Piston Accumulators. J. W. OVERBEKE. Aug 1953. Comparison of diaphragm type, bladder type, and piston accumulators.

Design with Central Accumulator Systems. L. MELCAREK. Dec 1951. Power generating equipment for a scrap collecting system in a steel mill.

Accumulator System Provides Overload Protection on Crusher. Dec 1952. Design of a gyratory crusher for stone and ore.

Five Ways to Use Accumulators. SEYMOUR S. GARRETT. Sept 1956. Presents circuits showing how proper valving arrangements permit the use of hydropneumatic accumulators to speed up production.

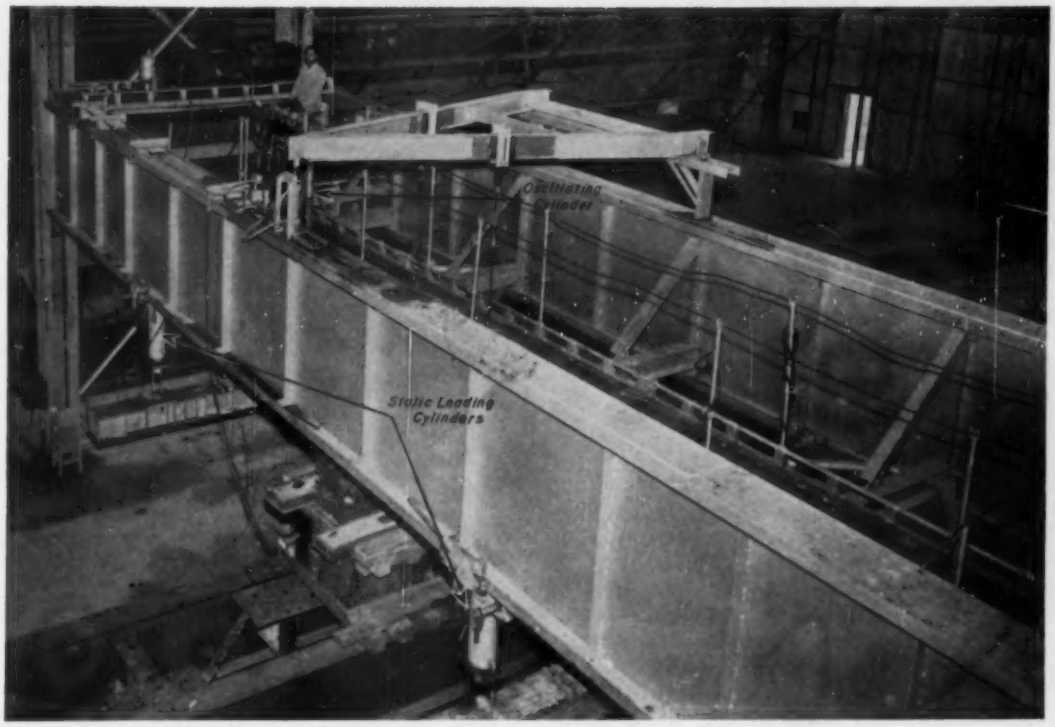


FIG. 1. DYNAMIC LOADS applied by the oscillating cylinder are controlled by a variable flow control valve which regulates frequency. Static loads to 400 tons can be applied.

HYDRAULICS SIMULATES BRIDGE LOADING

• By John Giliberto and Robert K. Hedrick

Project Engineers, Bridge & Marine Test Branch, U. S. Army Research & Development Laboratories, Fort Belvoir, Va.

Designed with a variable speed pump drive and meter-in flow control, this system applies oscillating as well as static loads for bridge development.

ON this bridge testing machine, the thrust of four hydraulic cylinders produces the static loading, and one hydraulic cylinder oscillates the bridge at its natural frequency. Full-scale military bridges are being tested in this way by the U. S. Army Engineer Research and Development Laboratories at Fort Belvoir.

The frame accommodates bridges 40-ft wide, 30-ft high. Structures up to 240-ft long have been tested. Four concrete-embedded columns spaced on 45-ft and 12-ft centers form a rectangular shape. These columns support a pair of girders 45-ft long and 5-ft deep, which may be raised or lowered.

The four hydraulic cylinders which apply static loads are supported by the girders. These cylinders have 6-in. bore and 18-in. stroke. When unloaded, they are free to move on rollers along the bottom flange of the girder for horizontal positioning. These cylinders are used either together or separately to produce uplift force up to 400 tons.

• **Static load circuit**—The hydraulic system for the static loading consists of two 3.5-gpm pumps, driven by a variable-speed, d-c, 10-hp, electric motor; bank of 4-way, 3-position valves; pressure manifold; and master loading valve. The four valves on the pressure manifold permit selection of the loading cylinders. A fifth valve will load all cylinders at once. The system can withstand pressures up to 10,000 psi, but working pressures are kept to 7500 psi.

By adding auxiliary weights, such as military tanks, to the 400-tons force of the static load cylinders, loads considerably above the 400-ton rated capacity may be applied. Applied loads are measured within a .5% accuracy.

• **Fatigue testing**—With this machine a bridge can be first loaded and then made to oscillate at its natural frequency, and at a desired amplitude, with a relatively small but properly timed external force. Material will seldom fail at a single application of a static load producing stresses at yield strength. However, a sudden failure may result from *repeated* applications of stresses considerably lower than the yield strength. This tester sets up oscillations in a bridge member which closely duplicate actual field service under heavy military traffic.

• **Oscillating circuit**—The circuit used in dynamic loading, or fatigue testing, consists of a 2½ gallon accumulator; filter; 3-way, solenoid-operated valve; two pressure relief valves; 2-in. double-acting cylinder; and a flow control valve adjustable from zero to 20 gpm. The same pumps are used for both fatigue testing and static loading.

For fatigue tests, fluid is pumped through the filter to the accumulator, where it is maintained at 1500 psi. The flow control valve regulates flow to the oscillating cylinder. Oscillations of the member being tested operate a two-way limit switch and energize the solenoid-operated, 3-way valve. This valve routes fluid to the oscillating cylinder, which exerts an uplift force on the test member at the precise instant it starts the upward path of its swing. This force counteracts the inherent damping forces and continues the oscillations at desired amplitude. At the upper limit, flow is reversed, allowing the member to return to the bottom of its path under gravity and kinetic forces.

Two relief valves limit internal pressure to 2500 psi, in event of any sudden failure of the test member.

The oscillating cylinder is connected at the apex of an A-shaped loading beam, which is mounted above and parallel to the test member. The loading beam is hinged at its legs, and connected by cables to the test member below. Vertical stroke is controlled by proper positioning of the cables on the legs of the A-beam.

The system has been relatively trouble-free, and after one million strokes the oscillating cylinder has required no maintenance or replacement of parts, and has given no indications of failure or loss of efficiency. ▼▼▼

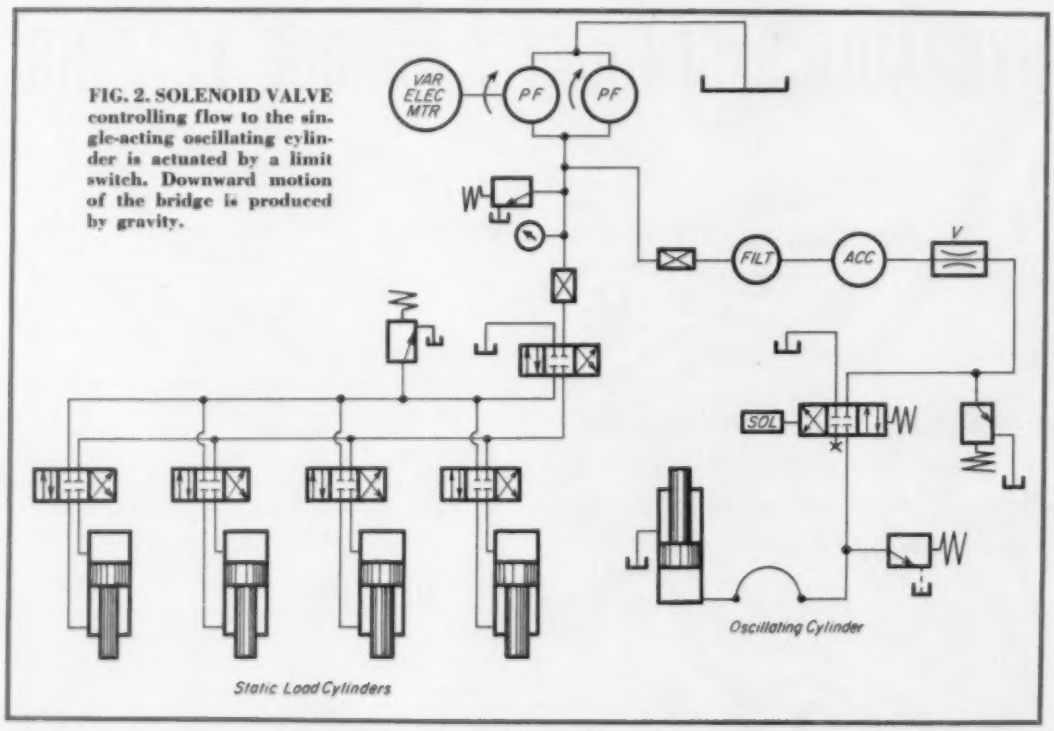
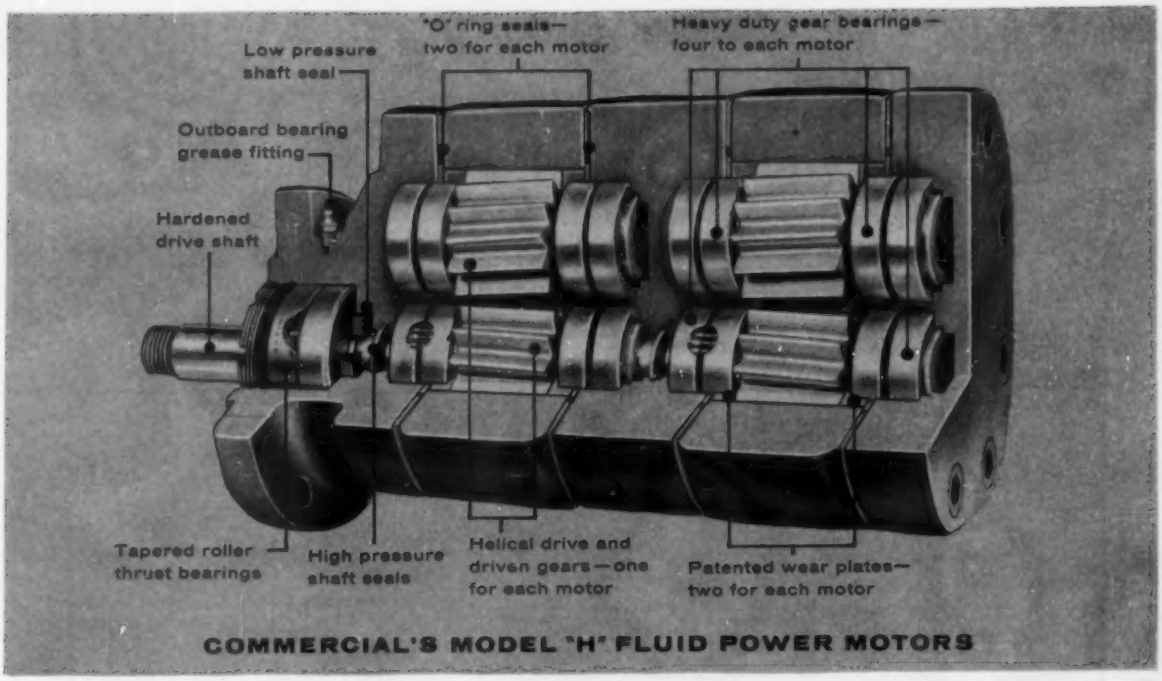


FIG. 2. SOLENOID VALVE controlling flow to the single-acting oscillating cylinder is actuated by a limit switch. Downward motion of the bridge is produced by gravity.


Low pressure shaft seal
"O" ring seals—two for each motor
Heavy duty gear bearings—four to each motor
Outboard bearing grease fitting
Hardened drive shaft
Tapered roller thrust bearings
High pressure shaft seals
Helical drive and driven gears—one for each motor
Patented wear plates—two for each motor

COMMERCIAL'S MODEL "H" FLUID POWER MOTORS

New ideas in fluid power motors

Multiple-speed drive simplified

Efficient operation of heavy mobile equipment frequently involves multiple speeds. Not so efficient, however, is the shifting of gears, the power take-offs, clutches and gear transmissions involved in gaining these desired speed levels with mechanical drives—not to mention the constant maintenance headaches these same drives entail.

Pictured above is one Commercial fluid power oil-hydraulic motor that now delivers low and high speeds efficiently—completely eliminates the problems mechanical drives ordinarily involve.

Two motors work in tandem

This Commercial Model "H" tandem motor actually involves two single motors of equal output mounted on one common drive shaft. When fluid power from the pump source is directed by simple valving into just one of the single motors, the shaft rotates at the high speed. The other single motor on the same shaft receives no input and therefore merely turns. When low speed is required, the total fluid power delivery from the pump is valved into both of the single motors. And of course motor torque at this reduced speed is doubled. This simplified control of two speeds—both low and high—is possible in either direction, forward or backward.

Each of the single motors in this Model "H" tandem motor has one-inch gears. With a fluid power input of about 15 gpm at 1200 psi, for example, when one of the single motors receives the entire input, rotation is 1200 rpm. When the same input is split between the two equal size single motors, rotation is 600 rpm.

Model "H" motors are available with gears in widths of 1", 1¼", 1½", 2", 2½" and 3". Any combination of gear sizes is practical.

More than two speeds

Even three speed operation can be obtained with Commercial double tandem motors when gears of different widths are used in each single motor. High speed operation results when the full pump delivery is valved to the motor with the smaller gears, intermediate speed when it is all directed to the larger gear motor, and slow speed when valved to both motors. One single motor having three-inch gears operating at 1600 psi at a speed of 1200 rpm would develop about 50 h.p. Commercial Model "H" motors are recommended for continuous duty operation at pressures up to 2000 psi and speeds up to 1800 rpm.

Engineering help available

Be sure to send for your copy of Commercial's "Oil-Hydraulic Motors Catalog H-4". Further information on Commercial's complete line of other fluid power components—valves, pumps and cylinders—is also yours for the asking, as is technical help and assistance from Commercial on fluid power applications.

Address inquiries to The Commercial Shearing and Stamping Company, Dept. A-44, Youngstown 1, Ohio.

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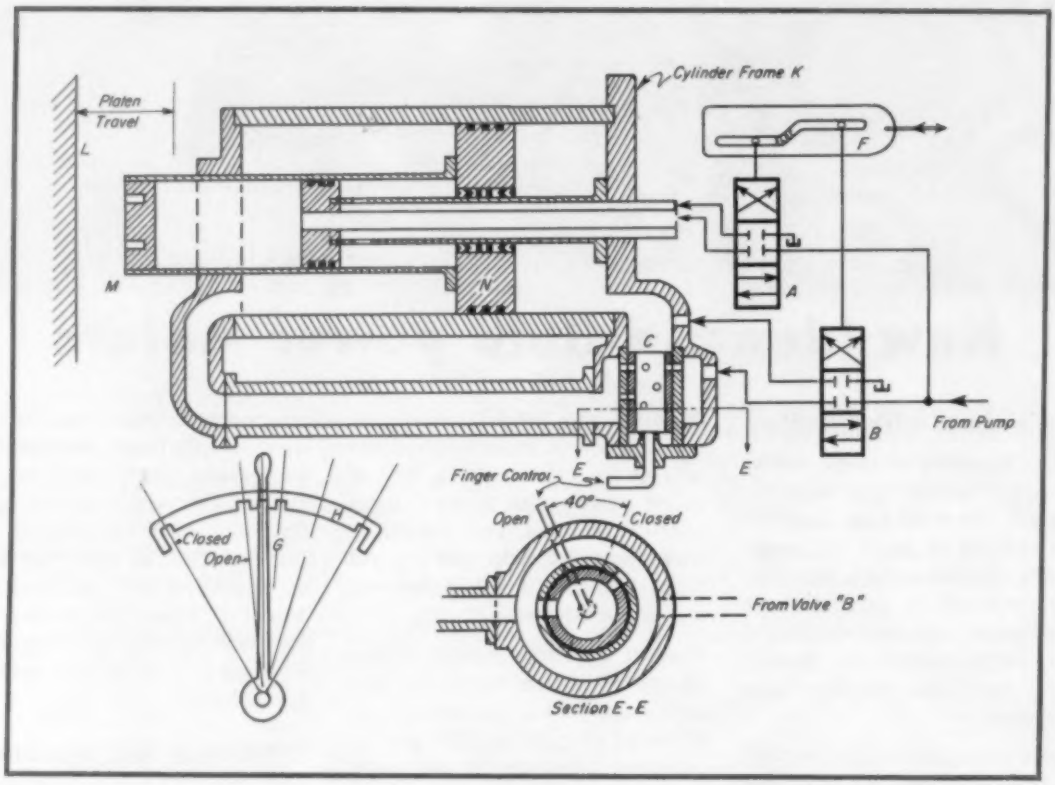
Manual control of

COMPOUND CYLINDER

regulates speed and force

• By O. G. Beardsley



DEVELOPED for applications where feed can best be controlled manually, this compound cylinder permits finger-tip operation of a 9-inch piston through a 32-inch travel.

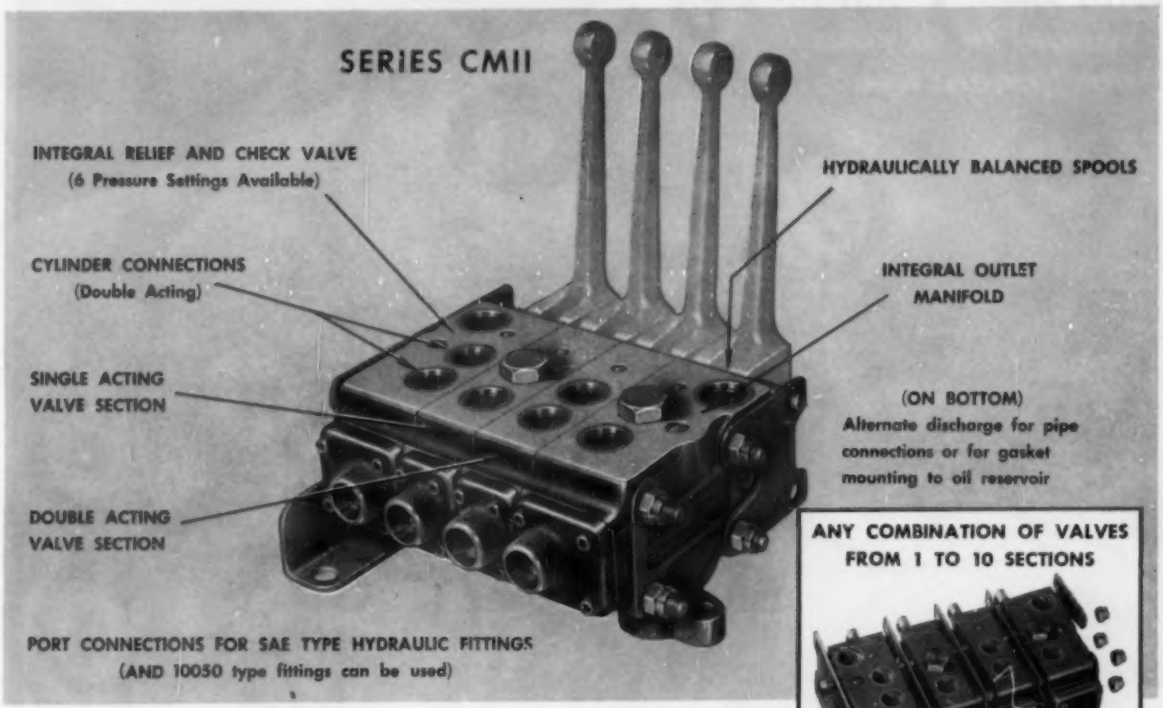
In the drawing above, cylinder frame *K* and piston *P* are stationary and the platen *L* slides when pushed or pulled by main piston rod *M*. The cycle starts with operating lever *G* in its vertical position as shown. Moving the lever to the left or right moves the platen *L* in the same direction. The first inch of lever movement in the desired direction actuates 4-way valve *A* so that the main piston rod moves in the corresponding direction. During this fast travel of the main piston rod, choke valve *C* is wide open connecting the head and rod ends of the large cylinder, so that fluid passes freely from one end to the other. The choke valve also connects both sides of the cylinder to tank to compensate for difference in flow between head end and rod end.

As operating lever *G* is moved farther from the starting position, valve *C* is gradually closed. This choking action which retards the speed of the main piston rod is the secret of the excellent speed and force control of the large piston.

The instant the platen contacts the work and maximum force is required, lever *G* is positioned to the end of the sector, opening valve *B*. This admits fluid to the large piston with the choke valve closed applying a high force to the work.

Operation of units of this design having pistons of 9 and 3½-inch bores has given smooth, sensitive movement. Applied pressures range to 2000 psi. ▼▼▼

For Improved Operation of Mobile Equipment



Improved Vickers CM11 Multiple Unit Valves

Improved control, greater convenience and economy have been provided by this new design of Vickers Series CM11 Multiple Unit Valves. They are widely used on such applications as: material handling equipment, farm tractors, construction and mining machinery, bucket loaders, and many other types of mobile equipment where accurate control of hydraulic power is required.

Simultaneous Functions

Valves may be operated individually or simultaneously. Saves operator's time on the job. Full pump delivery is available at any one valve when operated singly.

Precise Control

Improved metering characteristics and Vickers exclusive porting arrangement make possible a smooth and selective control . . . greater precision in nudging, crowding, inching and positioning. Valve spools are spring centered to neutral position and hydraulically balanced to prevent kicking-out due to excessive back pressure or surges. A check valve in the inlet prevents pressure surges at the cylinder from acting destructively on the pump.

Overload Protection

Tamper-proof integral relief valve provides excellent overload protection and low override characteristics. Relief valve is preset at factory to any one of 6 cracking pressures from 500 to 1750 psi (250 psi increments).

High Capacity

Maximum capacity is 12 gpm with three or less valve sections, or 9 gpm with over 3 valve sections. Maximum working pressure is 2000 psi.

Sectional Assembly

A high degree of control flexibility from minimum inventory is assured users requiring a variety of valve assemblies.

Seal Plate Subassembly

Steel spacer plate with rubber seals bonded in place allows rapid, leak-proof assembly of valve sections. Plate subassembly permits instant, positive joining of sections with no danger of overstressed through bolts and cramped valve spools.

Minimum Space and Weight

Simplified design and construction characterize CM11 valve assemblies. Valve end sections combine in one casting the inlet or outlet manifold together with any operating valve section . . . saving space and weight.

Easy Mounting

Mounting is a simple three-point installation. Cylinder connections are ¾-16 UNF-2B thread (SAE type) . . . inlet and discharge ports are ¾-14 UNF-2B thread (SAE type). Alternate discharge connections in bottom of end sections provides for gasket mounting to oil reservoir or to ½" threaded pipe.

Interchangeability

Interchangeable valve sections assemble for both original and conversion equipment with minimum stock requirements. Added operations are quickly accommodated simply by adding suitable valve sections.

For further information, write for Bulletin M5101A. 7852

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Lasting corrosion protection for valve stems in storage. Ordinary corrosion inhibitors fail to protect after the sacrificial metal is consumed. J-M No. 9 operates on an entirely different principle. Photograph shows how under accelerated tests, the sacrificial inhibitor (at left) failed after a few weeks *but the valve stem protected by J-M No. 9 (at right) was clean months later*. Specify J-M No. 9 inhibitor when you order J-M die-formed packing rings.

J-M Die-formed Packing Rings for all process fluids

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Check the tolerance chart below . . . your Johns-Manville Packing Representative will be glad to give you lists and descriptions of the styles in each range and those with which the J-M No. 9 Corrosion Inhibitor (*see right above*) may be specified or is standard. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE DIE-FORMED PACKING RING TOLERANCES	DENSE RINGS (including plastics)			SOFT RINGS (including cloth rings)			METALLIC RINGS		
	I.D.	O.D.	Depth	I.D.	O.D.	Depth	I.D.	O.D.	Depth
to and incl. ½" O.D.	+.008" −.000"	+.000" −.008"	±1/64"	+.008" −.000"	+.000" −.015"	±1/64"	+.008" −.000"	+.000" −1/32"	±1/32"
Over ½" to and incl. 1" O.D.	+.008" −.000"	+.000" −.008"	±1/32"	+.008" −.000"	+.000" −.015"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"
Over 1" to and incl. 2⅜" O.D.	+.008" −.000"	+.000" −1/64"	±1/32"	+.010" −.000"	+.000" −1/32"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"
Over 2⅜" O.D.	+.010" −.000"	+.000" −1/32"	±1/32"	+.010" −.000"	+.000" −3/64"	±1/32"	+.008" −.000"	+.000" −1/32"	±1/32"

Bevel (on all styles) ±5° when required

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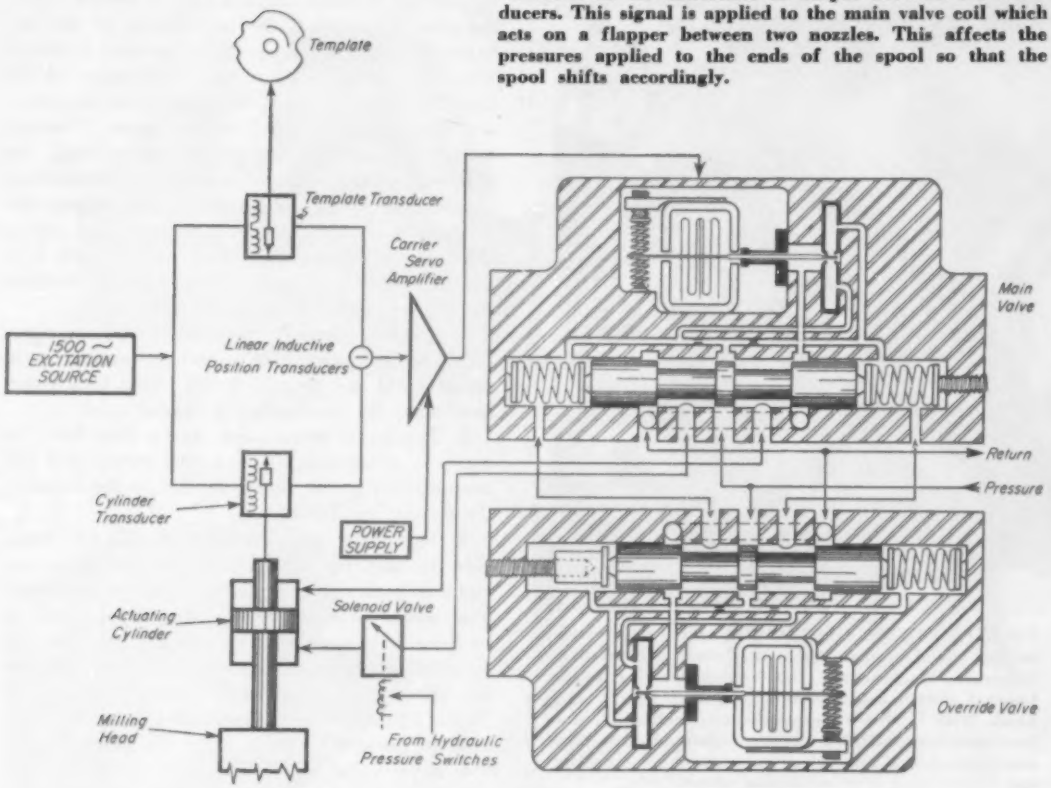


DIRECTION AND SPEED of the output cylinder are functions of the difference in output between the transducers. This signal is applied to the main valve coil which acts on a flapper between two nozzles. This affects the pressures applied to the ends of the spool so that the spool shifts accordingly.

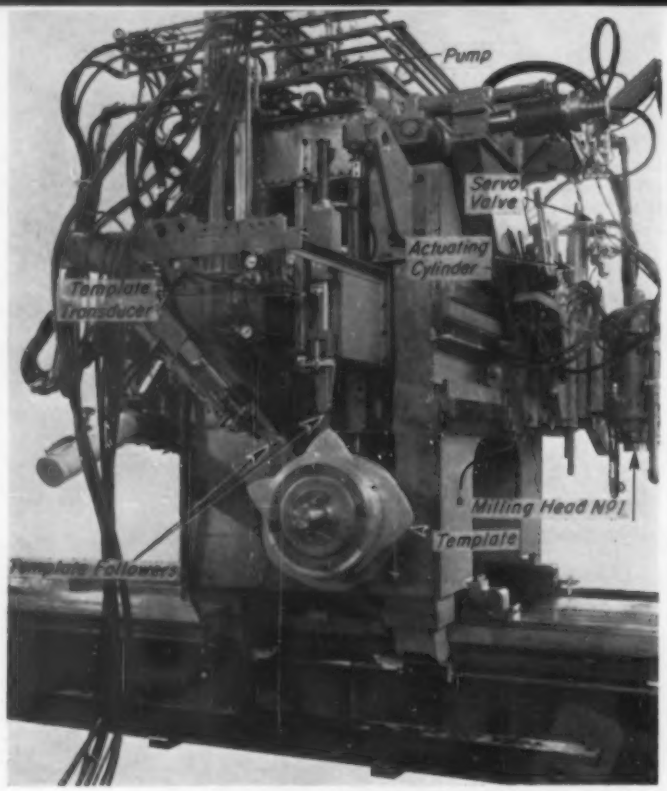
SERVO VALVE CONTROL

. . . for tracing on a spar mill

In this pioneer application of an electrohydraulic servo valve on a machine tool, the big advantage is in the electrical feedback and possibility of mounting templates in a group separate from the machine.

● By Alexander D. Roubloff
Chief Engineer,
Farnham Div. Wiesner-Rapp Co. Inc.,
Buffalo, N. Y.

REALIZING the advantages of an electrically controlled servo valve over the more conventional tracer type valve, for their spar milling machines, Farnham Manufacturing Div. began developing such a system in 1952. Two reasons were behind this development. First, Farnham engineers foresaw the need in the aircraft industry for more and more automatically controlled movements per milling head and the complications that would arise with the addition of each movement. For example in the early '40's, a 3 or 4-inch template movement and a 5 or 6-inch total movement of each head was fully sufficient. At present, machines may have as much as 18 inches of template movement and 36 inches total movement. Second, the conventional servo type tracer valve which had



VIEW FROM SIDE OF MACHINE shows one vertical milling head, helical template and two template followers. Machine has two vertical milling heads. Control system actuates axial rise and fall of each head. With feedback accomplished electrically, note how template and follower are separated from head and located in a convenient position where templates can be changed with minimum effort.

been used, had the disadvantage of requiring mechanical feedback. With the electrohydraulic servo valve there was the possibility of grouping all the templates in a separate package which could eventually even be separated from the machine.

At that time it was also realized that tape control can be applied to an electrohydraulic servo valve with much less trouble than any other valve.

The first machine built with this system has been in operation since 1954 and has definitely proved the success of this program. Since then several improved machines have been built and are successfully operating in the field.

SYSTEM OPERATION

The tracer system controls the cutting heads of the spar milling machine to follow the contour of a profile template. It also includes a safety system which retracts the cutting heads to the upper limit of their travel if any component of the control system fails and causes the cutting heads to lose contact with the template.

The closed loop system contains four basic elements:

1. A position-error detecting system is made of two transducers, which are essentially variable inductance elements consisting of a long center-tapped coil through which a core is moved. When the core is centered, the inductances of the two halves of the coil are equal. As the core is moved from the center position, the inductance of the coil half toward which the core moves increases, and that of the other coil half decreases. If an a-c voltage is imposed across the entire coil, the center-tap voltage will vary with the core movement, the voltage being larger across the higher inductance coil half. The units are designed with a high degree of linearity; they control with high accuracy the positional correspondence between the cutting head and the input template.

2. A control amplifier receives the voltage signal from the error detecting transducer system as its input signal and magnifies this signal to a power level adequate to actuate the control valve.

3. The 4-way servo valve directs flow from the pump to either side of the power piston at a rate proportional to the signal applied to the valve by the control amplifier.

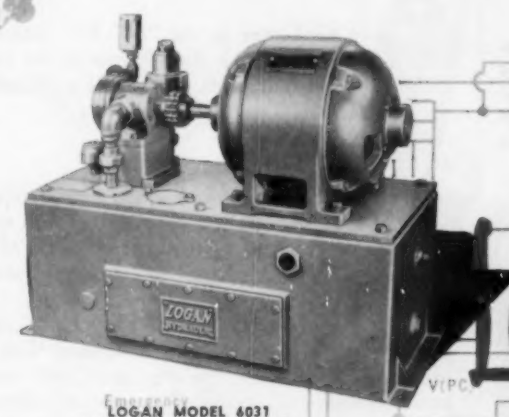
4. The power cylinder has a double rod extension so that the active areas of the piston are equal in both *rise* and *fall* directions of movement. The power cylinder moves the cutting head up or down at a speed corresponding to the flow rate established by the control valve. The cylinder has an effective area of approximately 20 sq. in. In the 1200-psi system, forces to 12 tons are available to move the cutter. Since the rated flow of the servo valve is 9.8 cu. in./sec., the cylinder velocity is limited to 30 in./min. Combinations of feed speed and template ramp angle must remain within this limit.

In addition to these basic elements, an electronic power supply converts the 110-volt 60-cycle line voltage to a regulated +300 volts and −150 volts d-c level to operate the control amplifier. An oscillator provides voltage across the error detecting transducers and is contained within the control amplifier.

The pump is a 2000-psi, 2-stage, vane-type unit. It contains two separate cartridges interconnected by integral valves. Each fixed displacement cartridge pumps across a 1000-psi differential. The valve is rated at 9.8 cu. in./sec. flow in a 1200-psi system with a full signal of 6 milliamperes differential current and no load. It is actuated by the difference in current in two halves of an integral, center-tapped coil. Oil supply to the valve must be free of magnetic dust and filtered with a 10-micron filter. No damage results to the valve for overpressures to 100% in the supply line. However, the drain line must not be restricted nor pressurized beyond 500 psi, nor should the drain pressure ever exceed the supply line pressure to cause reverse flow.

The override valve is a modified version of the main servo valve and is used to drive the main

Concluded on page 90



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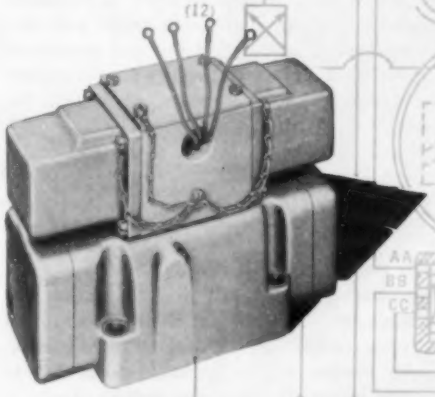
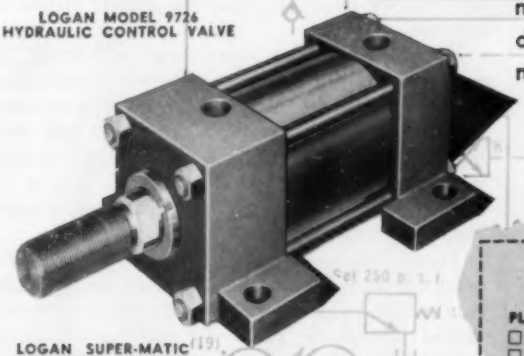


LOGAN MODEL 9726
HYDRAULIC CONTROL VALVE



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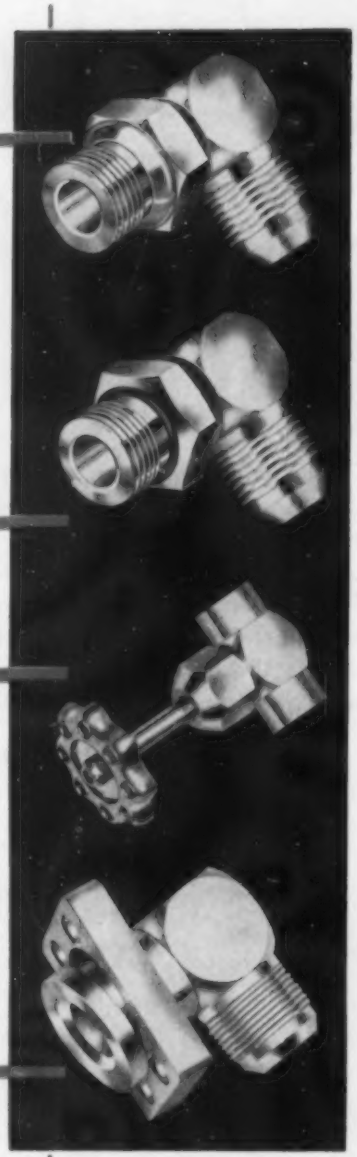

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SERVO VALVE CONTROL

Concluded from page 88

valve spool hard over in the "up" flow direction if current is interrupted. Both halves of the valve coil are connected in series without using the center tap connection.

ACCURACY

Under normal conditions, the control repeats its trace over a given pattern at a given feed speed within ±.002 in. for the total usable travel of the cylinder. With the carriage stopped, the control brings the cutting heads to within ±.003 in. of the true position called for by the template. Most of this error is due to transducer tolerance. With the carriage stopped, the cutting head will repeat position within ±.001 in. The control follows a template ramp angle up to 40 degrees at carriage feeds to 60 in./min. with a maximum tracing error of ±.005 in. This tracing error is repetitive and determined by template ramp angle and carriage feed speed. Since the tracing and positional errors mentioned are repetitive, by appropriate template design, overall accuracy of ±.002 in. can be held. ▼▼▼

TRIPLE CIRCUIT

Concluded from page 75

the pump during return, oil displaced from the ram by table motion is added to pump output to increase table return speed. At the end of the return stroke, another dog on the table shifts S, linkage reverses pump flow and the cutting stroke is repeated.

Medium speed and force range is selected by energizing valve R_2 with a selector switch. This shifts the three-way valve of P to connect both sides of cylinder X to the variable pump inlet side during the cutting stroke. At the end of the cutting stroke, operation of S reverses the four-way of P, and reversal of pump flow then produces the same rapid return as during low range operation.

Turning the selector switch to high range, deenergizes R_2 and energizes R_3. This applies pressure to the larger of the two pistons at the right end of the four-way valve of P and holds it in this position regardless of the position of S. Pressure is then applied only to the rod end of X for rapid cutting.

Energizing R_1 with a switch serves only to reverse the feed action so that it occurs at the start of the return stroke rather than the cutting stroke. Valve M prevents undesired operation of the feed mechanism through the linkage each time the table is stopped.

Flow rates of the variable-displacement pump are independently adjustable for each direction of flow. This allows any desired return speed to be selected regardless of cutting speed range, or pump adjustment for speed selection within a range. ▼▼▼

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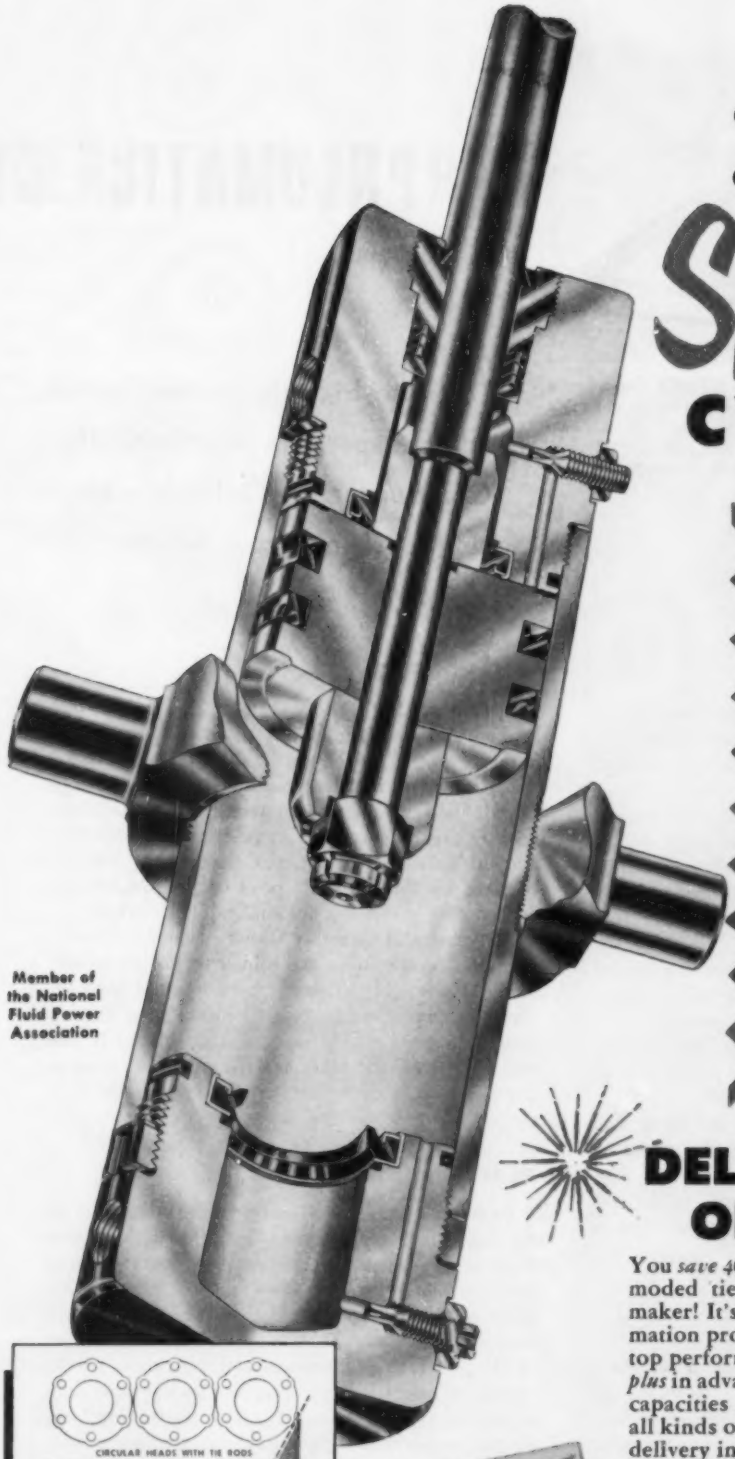

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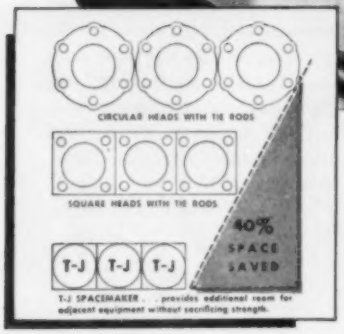
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PNEUMATIC CYL

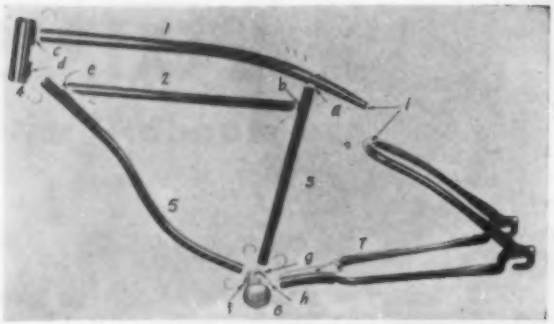


FIG. 1. COMPONENTS OF A TYPICAL FRAME for a boy's bicycle. Various joints are indicated by letters *A* through *H*. Frame members are: 1. Upper Crossbar; 2. Lower Crossbar; 3. Vertical Member; 4. Head Tube; 5. Lower Tube; 6. Hanger Tube; and 7. Rear Subassembly.

To braze bicycle frames faster and cheaper, the Westfield Mfg. Co., builders of Columbia bicycles, designed new fixtures

A BICYCLE frame has six tubular members and a rear subassembly. To speed production and reduce costs of its Columbia bicycles, Westfield Mfg. Co. recently changed from a dip brazing to a silver brazing method offering substantial economies. With dip brazing, each joint had to be drilled and pinned before brazing. Additionally, quantities of the brazing material had to be removed, largely by hand, from portions of the frame where this excess material was undesirable.

In the new process, frame members are placed in precision fixtures, preformed silver brazing compound placed in position, frame members are clamped and an automatic brazing and cooling process initiated. Air cylinders used in the clamping operation maintain accurate alignment of the various members during brazing and cooling and at the same time will permit the small amount of movement necessary because of expansion and contraction. All cylinders have a 1-in bore and 1½ in. stroke. Operating pressure is 40 psi. Operation is from the plant air supply furnished by two 300 cfm compressors.

SIZE COMPENSATION

Since bicycles are produced in a range of sizes, the fixtures are designed to handle as many of these sizes as possible with only minor adjustments. An additional advantage of pneumatic clamping shows up here. As the air cylinders extend to clamp the frame members, they automatically stop when the required force is exerted regardless of the amount of extension. Thus no adjustment is required to compensate for variations in length of parts within the range of cylinder stroke.

●**Operating Sequence**—Frame assembly is performed at four stations. At the first station crossbars are joined to the vertical member. The parts are positioned by the operator who then drops slugs of silver brazing compound down the crossbars against the vertical member. Operation of a manual valve then advances the clamp cylinder. Burners are then slid into position and the brazing and cooling cycles are automatically performed.

At the second assembly station, head tube, lower tube and hanger tube are joined to the previously made subassembly. Two air cylinders are used for clamping here. One extends a tapered plug directly into the open end of one of the tubular frame members while the other applies a saddle clamp to the lower crossbar by means of a mechanical linkage.

REAR SUBASSEMBLY

Rear subassembly is joined to the remainder of the frame at station three. Clamping is done with three air cylinders. One cylinder holds the frame by inserting a plug into the vertical member, another holds the head tube and the third clamps the rear of the rear subassembly. At this station, as at the other two, extension and retraction of the clamp cylinders is controlled by the operator with a manual valve. Although the hanger tube was placed in position before inserting the frame subassembly in the fixture at station two, all three joints at the hanger tube are brazed at station three.

Final step in the assembly is to braze joint *K*. This is done in an air fixture. Any slight misalignment which may have occurred during previous operations is corrected here. ▼▼▼

INDERS CLAMP PARTS FOR BRAZING

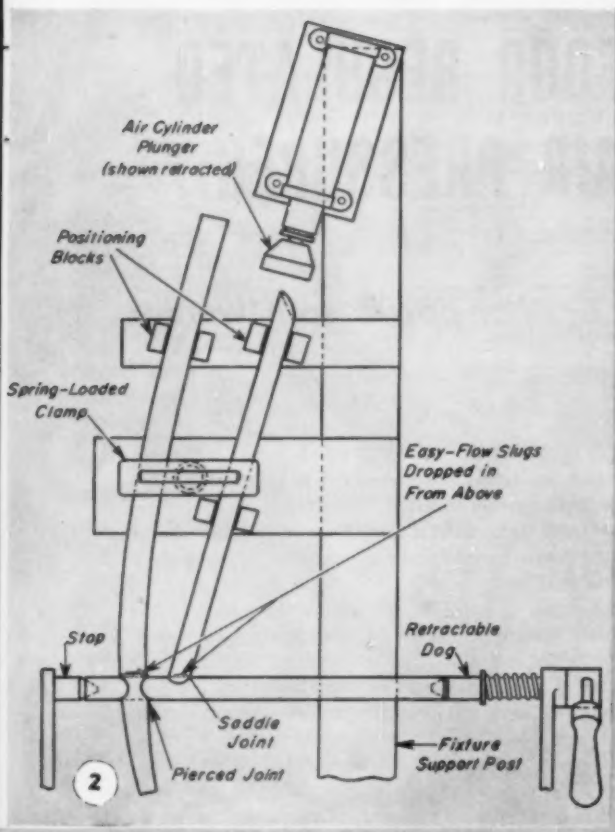
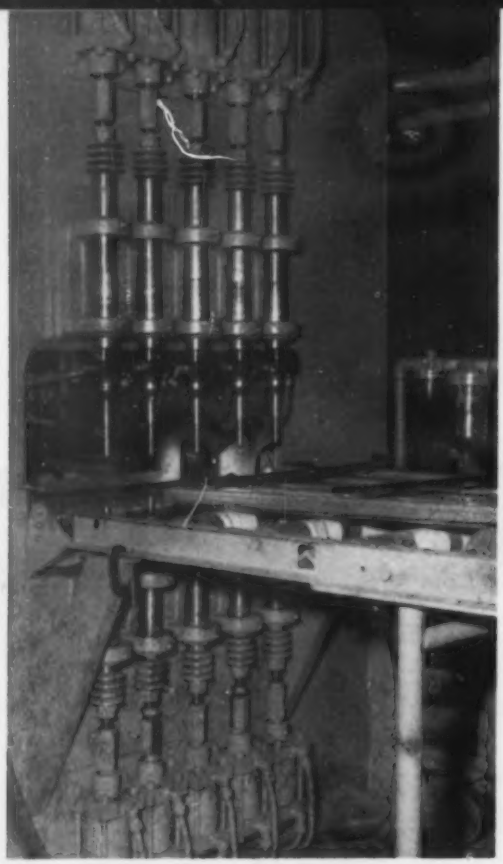


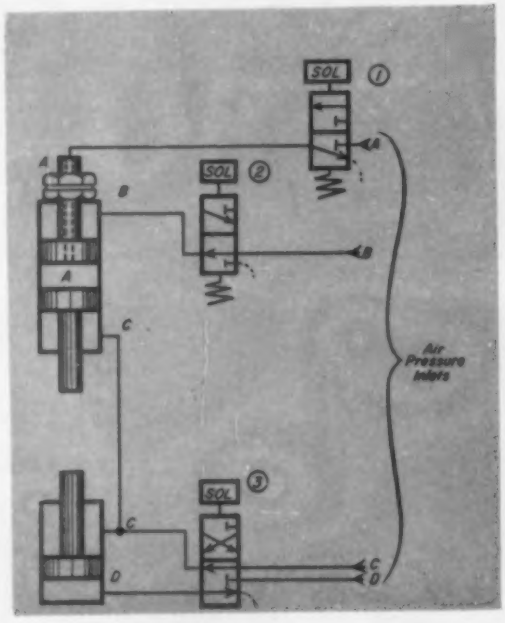
FIG. 2. UPPER AND LOWER CROSSBARS are joined to the vertical member at the first assembly station. Silver brazing compound is simply dropped into the crossbars after positioning in the fixture.

FIG. 3. TWO AIR CYLINDERS are used for clamping at station two. Hanger tube is installed to facilitate clamping. Lower tube and head tube are brazed to previously joined members.

FIG. 4. REAR SUBASSEMBLY is joined to the rest of the frame at station three. All three joints at the hanger tube are made here. Three air cylinders are used for clamping.



FIVE SPOT weld tips can be operated independently in any sequence by either manual or timer control.



AIR CIRCUIT shows one pair of five sets of weld cylinders. Two 3-way valves are used for control of the upper parallel connected cylinders. A separate dual pressure valve controls each lower cylinder and air flow into the lower rod end of the upper cylinder.

Stiffener members are spot welded to corrugated aluminum sheets on this specially designed machine. Finished assembly is used in building construction for roof decks and siding. Wide variety of corrugation spacing and depth, along with differences in the stiffener members, calls for a spot welder which can be quickly adjusted.

FOUR REGULATED AIR PRESSURES

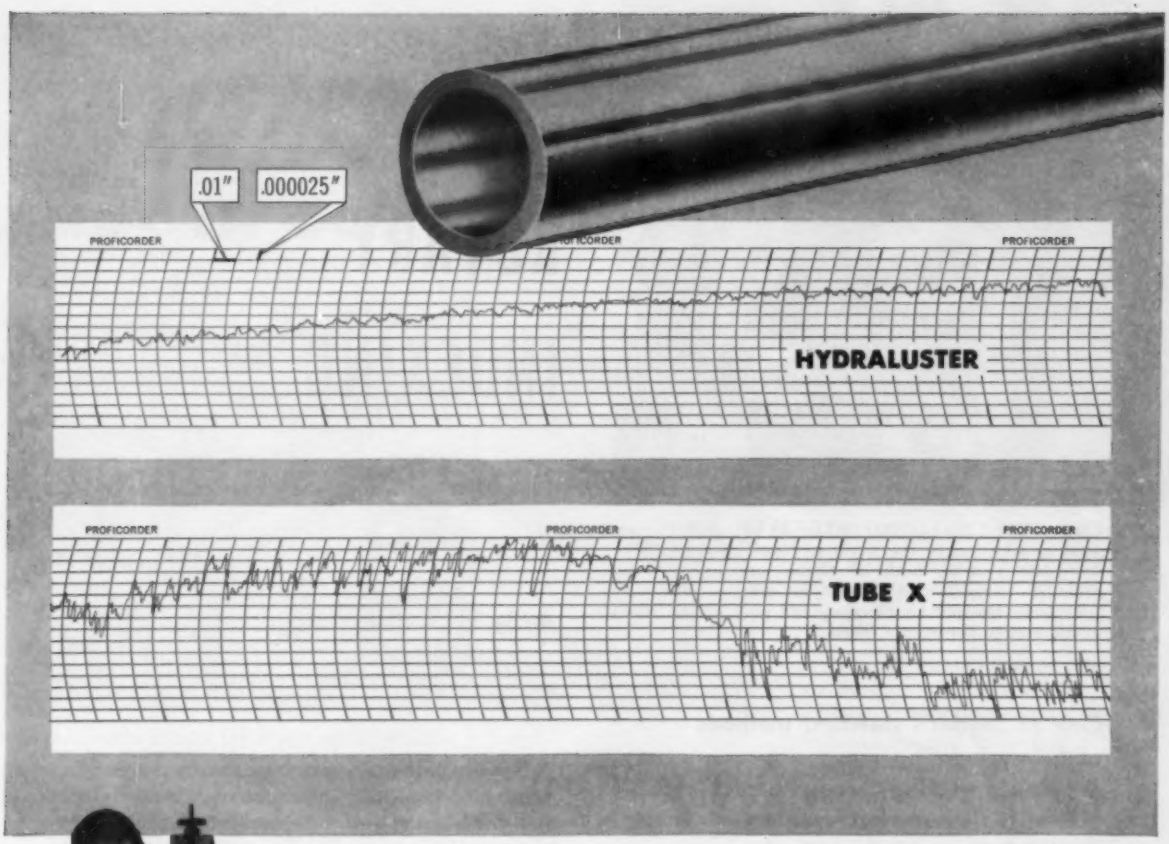
. . . power spot welder

FIVE tandem air cylinders which power the upper spot weld tips are connected in parallel so that they all operate together. The lower cylinders, are operated independently or in sequence. Each lower cylinder is controlled by a two position, 5-port directional control valve.

Control of pressure determines the action of the upper cylinder. If solenoid valve 3 is not energized, the lower cylinder does not operate and air pressure at C on the upper cylinder can keep this cylinder stationary if this pressure creates an upward holding force to balance the downward force produced by pressure A. Pressure A will be the same on all upper cylinders while pressure C is separately regulated for each cylinder. If pressure A develops a force to overcome that created by C, the upper cylinder will close while the lower cylinder remains stationary.

Both the upper and lower cylinders will move to complete a spot weld when valves 3 and 1 are energized. Pressures A and D are then the welding pressures. Deenergizing valves 1 and 3 causes both cylinders to retract. Pressure B holds the upper piston on the upper cylinder against adjustable stop nuts while pressure C raises the lower piston until it meets the upper piston. This arrangement permits adjustment of piston travel so that the upper weld gun can clear a rib in the workpiece as it is moved to the next welding station.

This welder was designed by Robertson-Irwin Ltd., Hamilton, Ontario for use in their plant. ▼▼▼



VERIFICATION: Measurements of Hydraluster and Tube X were made on The Proficorder—an instrument of our manufacture for accurately showing the true profile of practically any machined or finished surface. The tests were conducted in our laboratories under my personal supervision. And I verify that both tubes were measured under identical conditions. The resulting graphs show the exact differences in the samples furnished. **Douglas Palmer — Chief Inspector, Micrometrical Mfg. Co., Ann Arbor, Mich.**

In micro-inch comparison of hydraulic tubing . . .

HYDRALUSTER shows smoothest, most friction-free I.D.

These graphic red lines are recorded measurements showing a surface profile *inside* both HYDRALUSTER and a length of standard hydraulic tubing. *Both tubes were selected at random from warehouse stocks,* then accurately measured in microinches by the sensitive stylus of the famous PROFICORDER.

Hydraulic system efficiency and dependability, in a large degree, depend on factors illustrated by the red lines. Tube X is *not* a scrap piece of tubing. In fact, it represents a quality grade purchased and used every day. Which tube would you select to offer the least resistance to hydraulic flow . . . to transmit fluid with the least amount of pressure drop . . . and to create the least fluid turbulence?

Hydraluster is the answer, of course. And Hydraluster is the right tube to specify when you want to insure these same performance characteristics in your hydraulic systems.

SAMPLES AND SPECIFICATIONS: Examine Hydraluster finish yourself. Your name on company letterhead will bring specifications and a sample by return mail. *Hydraluster is sold at standard carbon hydraulic tubing prices.*

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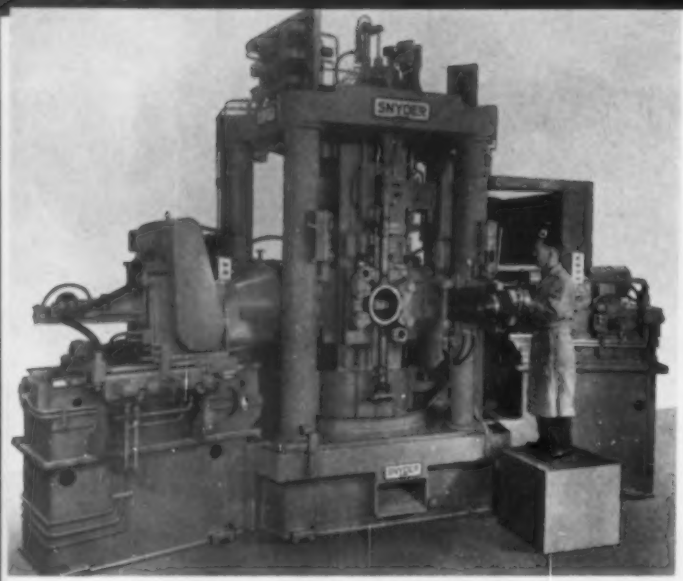


TWO SELF-CONTAINED HYDRAULIC UNITS are used in addition to the main hydraulic system. Like the main system, both of these are supplied by pressure compensated, vane-type pumps. Maintenance is minimized by bleeding off part of the main pump output through a filter.

ROTARY INDEXING

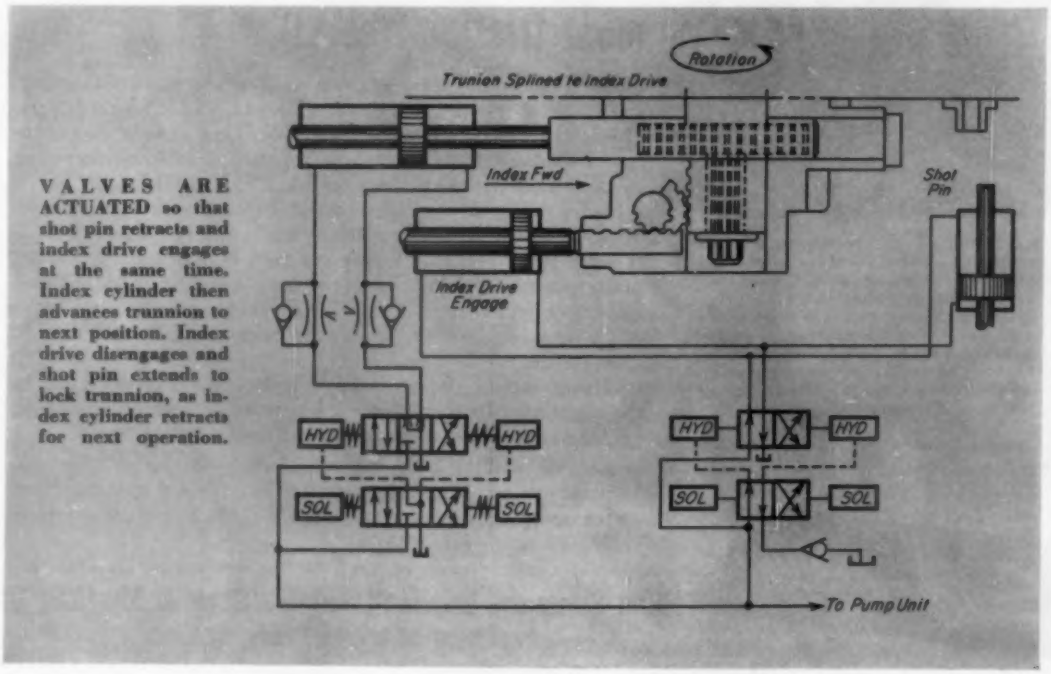
. . . with cylinders

One of Snyder's standard methods of rotary indexing uses a cylinder working through a rack and pinion. It's usually less expensive than a fluid motor and simpler because gearing is reduced.

● By H. Cutler

Control Engineer,
Snyder Tool & Engineering Co.,
Detroit, Mich.

ON many of their index tables, and on the vertical trunnion machine shown above, Snyder Tool and Engineering Co. uses double-acting cylinders to get rotary motion. The five-station machine was designed to reduce floor space requirements in machining long parts such as automotive axle housings, and it has the space saving advantages

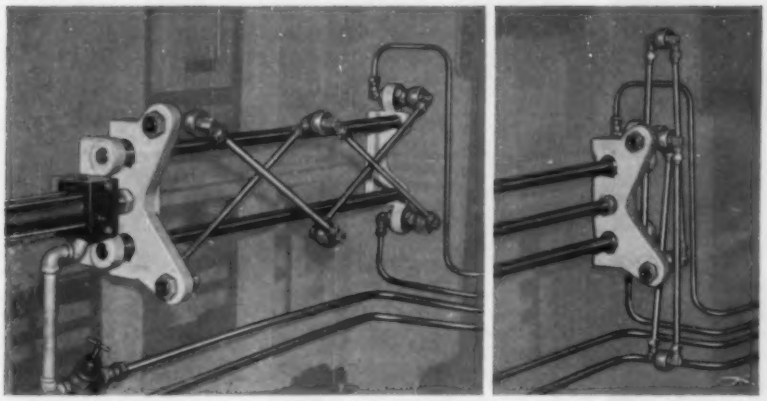


VALVES ARE ACTUATED so that shot pin retracts and index drive engages at the same time. Index cylinder then advances trunnion to next position. Index drive disengages and shot pin extends to lock trunnion, as index cylinder retracts for next operation.

IN EQUIPMENT DESIGN ■

CHIKSAN SWIVEL JOINTS

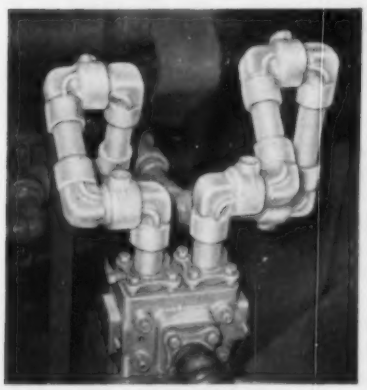
SMOOTH OUT KNOTTY LINE PROBLEMS



STEEL LINES FOLD LIKE AN ACCORDION

Connected to a moving head, these compact swivel jointed all-metal hydraulic lines flex and fold like an accordion on this automatic bottle unpacking machine.

When a machine's moving parts cause tight bend or twist on hose lines, Chiksan Swivel Joints provide a ready solution. When design dictates the use of metal lines, Chiksan Swivel Joints allow rubber-like flexibility. In fact, wherever line flexibility is required, designers and maintenance engineers know it's just good business to call on Chiksan. Precision made Chiksan Swivel Joints with their infinite service life, full 360° rotation and high safety factor, quickly pay for themselves by minimizing hose replacement and eliminating costly line failure, fluid loss and downtime. If your equipment hose lines require frequent replacement due to torsion or bend radii fatigue, or if flexible all metal lines are in order, contact Chiksan. A nearby representative will call, analyze your requirements, and make specific recommendations. Write today for his name.

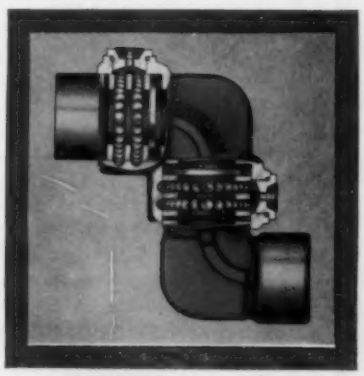


NO HOSE BURST HERE

These Chiksan swivel jointed steel lines on a die casting machine eliminate damaging hose ruptures, reduce fire hazard, fluid loss and setup time by 75%.

NO BEND FATIGUE HERE

This highly specialized lens grinder utilizes Chiksan Swivel Joints to eliminate tight hose bend as the multiposition head is shifted from one grinding position to another.



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Master unit mechanism compensates for expansion and contraction of fluid due to temperature changes. Relative position of Master and Slave levers is instantly adjustable by opening equalizer screw in either unit.

The Hydronic Remote Control System—is self-filling—no need for accessory pressure equipment—operates in any position. Filling and bleeding is easy and clean.

Hydronic's closed hydraulic system overcomes many problems associated with mechanical controls.

WRITE TODAY FOR COMPLETE INFORMATION ON HOW HYDRONIC CAN SIMPLIFY YOUR CONTROL PROBLEMS

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12685 ARNOLD
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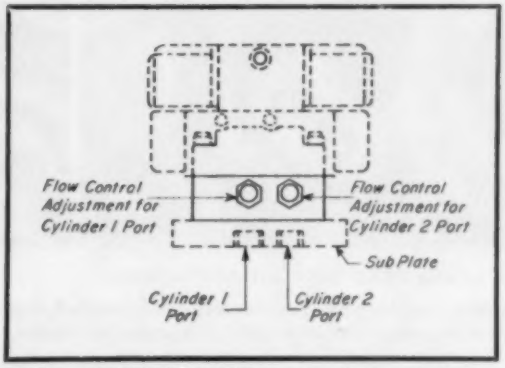
of a center-column type machine tool. The table holds the tall work fixtures and rotates the parts from station to station. Upper and lower tapered roller bearings support the tall trunnion-type fixture.

As shown in the diagram, three cylinders are arranged for the functions required in rotary indexing. One of these actuates the shot pin to lock the trunnion in position. A second cylinder engages and disengages the index drive, and a third cylinder actually rotates the trunnion through a rack and pinion.


Flow Control Adjustment for Cylinder 1 Port
Flow Control Adjustment for Cylinder 2 Port
Sub Plate
Cylinder 1 Port
Cylinder 2 Port

FLOW CONTROL VALVES regulating indexing speed mount compactly between the directional valves and the mounting plates. Each flow control is adjusted individually, and check valves permit unrestricted return flow.

Speed of indexing is regulated with two flow control valves incorporated into a single housing which is mounted between the directional value and the valve panel. This results in considerable space saving since all valves for this cylinder occupy no more space than required by the directional control valve alone.

The flow control valve regulating speed of index is adjusted according to the part being machined, the tooling, and other factors. The other flow control valve is adjusted for a slow return of the index cylinder, so that more oil is available for other functions such as clamping and locating supplied by the same pump. ▼▼▼

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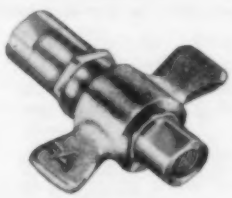
FUEL, OIL, WATER, HYDRAULIC LINES—Single Wire Braid 1503 and 1502 Hose for medium pressure hydraulic, water, hot oil, crude and fuel oil, anti-freeze, gasoline, diesel fuel and air lines. In sizes from ¼" to 2½"; pressures up to 3000 psi.; temperatures from —40°F. to +250°F. Also available: 2651 Rubber Cover Hose.

HIGH PRESSURE LINES—Double Wire Braid 1509 Hose for high pressure hydraulic, grease, crude and fuel oil, gasoline and air lines. In sizes from ¼" to 2"; pressures up to 5000 psi., depending on size; temperature range —40°F. to +200°F.

LOW PRESSURE LINES—Aeroquip 2556 Hose and *SOCKETLESS* Fittings for low pressure oil, fuel and air lines on all applications. In sizes from ¼" to ¾"; for pressures up to 250 psi., temperature range —40°F. to +250°F. *SOCKETLESS* Fittings in male pipe, S.A.E., J.I.C. threads. (Patent applied for.)

HIGH TEMPERATURE LINES—2802 Hose (Teflon) and Reusable ***"super gem"*** Fittings for fluid systems subject to high temperature and corrosive fluids. Hose and fittings can be assembled with ordinary hand tools. In sizes from ¼" to 1"; for pressures up to 1500 psi.; temperature range —100° F. to +500° F.



SELF-SEALING COUPLINGS—Type 5100 (wing union nut) and Type 5110 (hex union nut) allow quick connection and disconnection of fuel, oil, hydraulic and air lines, replaces two shut-off valves. There is no loss of fluid or inclusion of air into the system on connection and disconnection of fully pressurized lines. In O.D. tube sizes from ⅛" to 1½"; for pressures up to 2000 psi.; temperature range —40° F. to +250° F.

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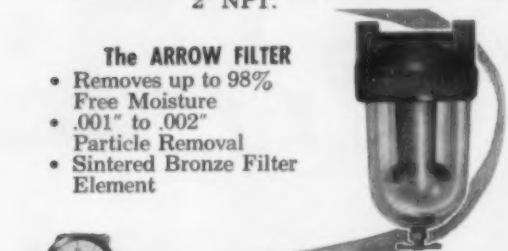

The ARROW REGULATOR
- Self Bleed Assures Accurate Control
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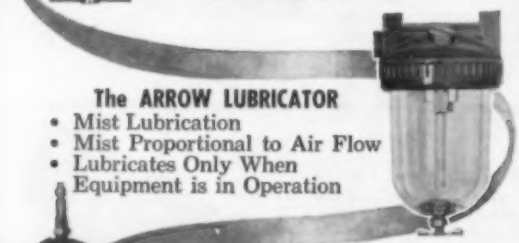

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LOW TEMPERATURE OPERATION

Concluded from page 72

• **Inlet Conditions**—Because pressure drop in the pump inlet line is higher with higher fluid viscosity and because air solubility in petroleum oils is higher at low temperatures, pump inlet restriction must be kept low to prevent cavitation, Figure 5. Cavitation occurs when pressure in the inlet line drops enough below atmospheric to allow gases and air dissolved in the fluid to come out of solution. The entrained bubbles lower pumping efficiency and cause vibration and noise as they collapse on the pressure side of the pump. Fatigue and erosion of pump parts can result from cavitation.

Inlet piping should, therefore, be short, straight and of adequate size. Location of the pump to produce a static head on the inlet side is very desirable. One pump manufacturer suggests that fluid level be 12 to 18 in. above the pump inlet to minimize the possibility of cavitation.

• **Filters**—Filters on the inlet side of the pump should be used with caution when operating at low temperatures. The restriction they offer may result in cavitation. Recommended practice is to use only a fairly coarse strainer on the pump inlet line and perform further filtration for fine particles on the pressure side. Since water from condensation is more a problem in low-temperature systems than in systems operated at normal temperatures filters are also important for removing this water.

When used on the pressure side of the pump, filters must be protected by bypass relief valves. Pressure drop across a filter can be many times higher when oil is cold than when at normal operating temperature. Unless adequately bypassed, filter elements may be collapsed by excessive pressures because of thick oil. ▼▼▼

APPLIED HYDRAULICS acknowledges with thanks the cooperation of the following companies in providing information for use in this article.

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Webster Electric Co. .....Racine, Wis.
Wisconsin Hydraulics Inc. .....Milwaukee, Wis.

Additional Reading!

"The Low Temperature Application of Industrial Hydraulic Oils," D. K. NASON, NCIH Proceedings, Vol. VI, 1952

"Low Temperature Hydraulic Operations" Lubrication, October 1952.

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Circle 130 ⟶

Comparative Tests Prove . . .

Sunvis 900 Oils have years of useful life under severe operating conditions

Versatile, long-lasting Sunvis® 900 oils are especially made to provide superior lubrication at high temperatures and in the presence of moisture. *They keep maintenance costs low.*

Time and again, when checked against new-oil specifications, used Sunvis 900 oils prove themselves fit for many more years of continued service, with *no* loss in performance features.

For example: The 3-year-old sample above was used in an injection molding machine operated for 40-48 hours per week at temperatures between 100 and 125 F. To see how the used oil compares with its original specifications look at the following table.

Specifications	New Sunvis 916	Sunvis 916 After 3 Yr*
API gravity at 60 F	30.5-32.5	30.3
Flash, open cup, deg F, min	400	400
Fire, deg F, min	460	460
Viscosity, SUS at 100 F	150-160	173.0
Viscosity index	90	90
Neut. number	0.10	0.05
Color, ASTM	1-1.5	3.5

*Typical Test

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Call your Sun representative, or write for Technical Bulletin No. 35, Sun Oil Company, Philadelphia 3, Pa., Dept. I-7.

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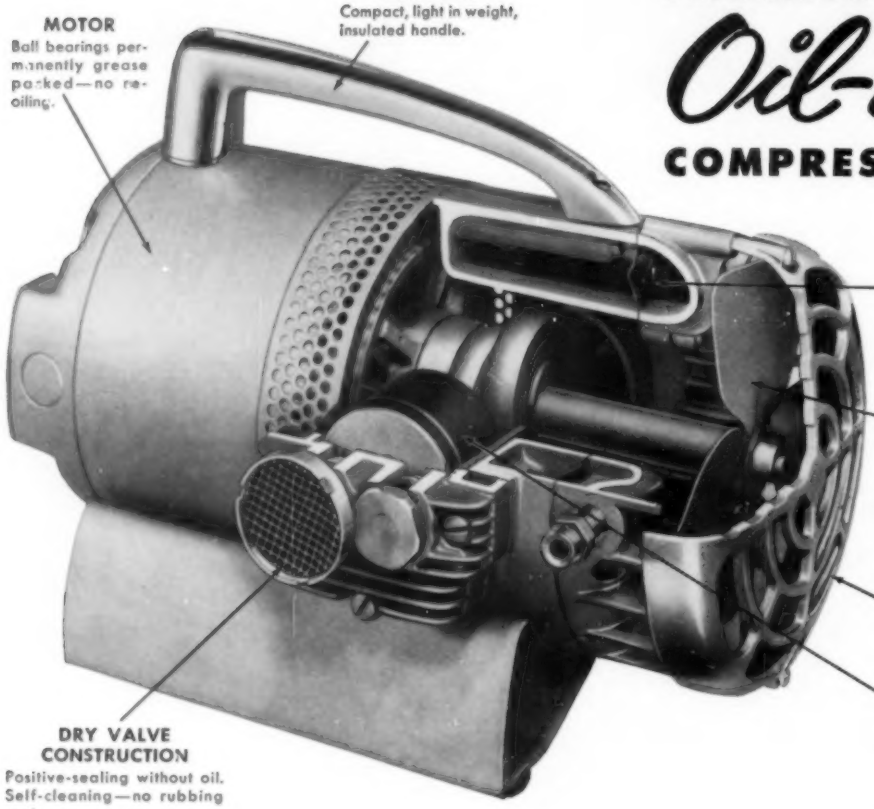
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Compact, light in weight, insulated handle.
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AUTOMOTIVE TYPE FAN
Assures low temperature operation for higher efficiency, longer life.
SAFETY VALVE
(Not visible)
Provides constant bleed-off at maximum pressure. Also acts as automatic moisture drain.
GRAPHITE PISTON RINGS AND SKIRTS
Special composition needs no lubrication. Self-sealing piston ring joint reduces blow-by.
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Positive-sealing without oil. Self-cleaning—no rubbing parts.

AIR WHERE YOU WANT IT... COMPLETELY OIL-FREE... COOLER... DRIER!

Expensive lubrication maintenance completely eliminated!

Where *clean* compressed air is essential, the B&G Oil-less Compressor provides the answer in a complete line of portable, tank-mounted and tankless models.

There is no oil required in this new design unit! Motor and compressor are permanently grease packed... graphite piston rings and skirts operate for years without destroying the mirror-finish of the cylinder walls. Since the cylinders are not lubricated, oil-free air is delivered at all times without need for an oil separator.

B&G Compressors are really *smooth!* Modern design large bore, short stroke, horizontally opposed pistons provide better balance and vibrationless operation. Compactness and light weight adapt them ideally to either portable or built-in applications. In every detail these units are designed to deliver *maximum air per horse power!*

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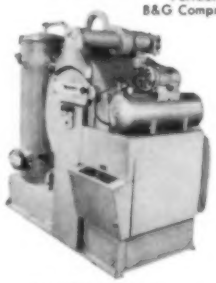

B&G Oil-less Air Compressor as integral part of dry cleaning machine

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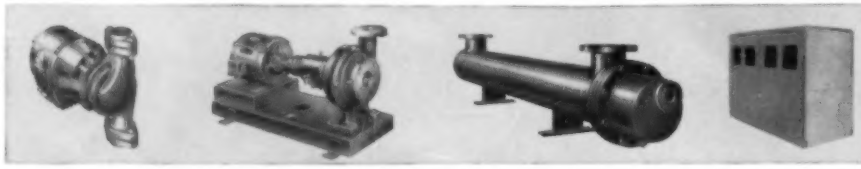
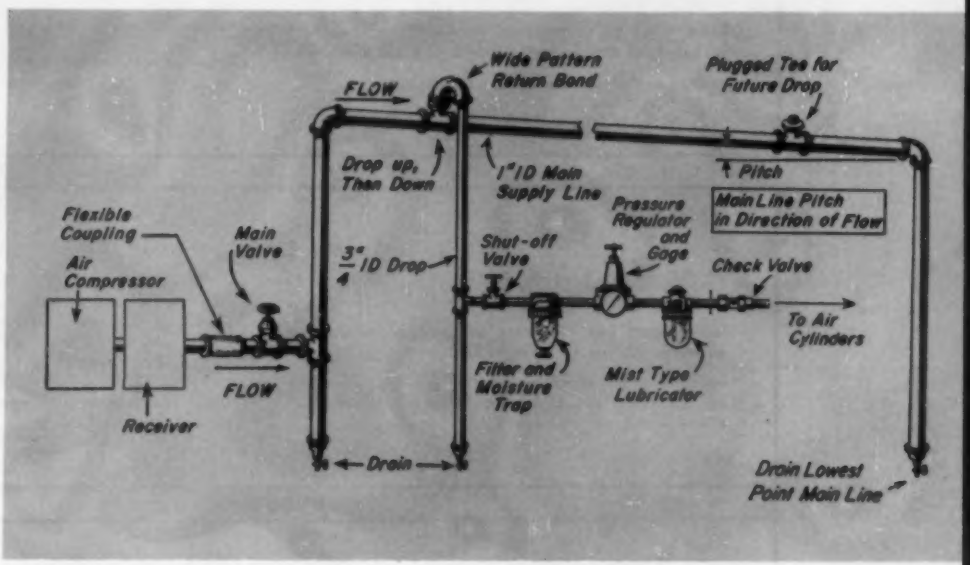


MAKERS OF HEATING AND COOLING SPECIALTIES, PUMPS, HEAT EXCHANGERS

Use of pneumatic machines and tools is rapidly increasing, but the full advantage of this high-speed, low-maintenance equipment is not always realized due to basic deficiencies in the air systems.



AIR SYSTEM offers maximum productivity for air equipment with minimum maintenance and downtime. Air is filtered and lubrication is automatic. When main supply line is looped, a drain should be installed at the low point in the line at the farthest point of the loop.

CHECK YOUR COMPRESSED AIR CIRCUITS

• By Frank Ledwitz

MAXIMUM productivity from any air circuit, with minimum maintenance and downtime, requires a continuous supply of clean, dry air at proper pressures.

• **Things to watch**—Compressed air is an economical, dependable type of power. However, there are certain possible causes of trouble which are common to all compressed air systems. Moisture, line pressure drop, and overloading are the three most common causes of trouble.

Moisture, and to some extent oil, may be introduced into utility air lines from the compressor. In addition, moisture condenses in the air supply piping. Moisture in any utility air system may cause corrosion in valves, cylinders and tools, but even worse, if it combines with oil, the two will form a sticky emulsion to cause clogging.

In any air system, pressure drops as it travels through the piping. The amount of the drop depends on pipe size and length of the run. The larger the inside diameter of the pipe, the less the pressure drop over a given distance. Fittings, such as valves, ells, etc., cause greater pressure drop than equal lengths of straight pipe of the same size.

Overloading a compressed air system with more equipment than it can handle will also cause pressure drop. If either the compressor or the distribution system is incapable of supplying the volume of air required by all the tools and cylinders attached to it, the desired pressure cannot be maintained.

Foreign matter in the air lines is another common source of trouble. Atmospheric dust and dirt are filtered out before compressing. However, dirt,

FRANK LEDWITZ, *Manager, Technical Customer Service, Swingline Industrial Corp., Long Island City, N.Y.*

Compressor Pointers

Mount firm and level in well ventilated location. Do not obstruct air intake. Face flywheel to the wall.

Preselect location of drain to be accessible at pail height or higher.

Drain regularly as moisture conditions require. Petcock may be slightly cracked for continuous bleed off.

Inspect and clean intake filter regularly.

Since unit vibrates, it may be desirable to connect to air supply line through flexible coupling.

Unit should only run 25% of the time. If it begins to run more than 75%, check for overloading, mechanical difficulties, or leakage in the system.

Install a non-restrictive valve in the main line near the receiver outlet for overall system control.

Supply Line Check-up

Use good clean pipe, free from rust, scale, dirt.

Incline main line downward in direction of flow so all water will run to a known low point.

Install a drain at every low point, being sure they are accessible and at convenient height. Watch that drainage will not damage work in process.

Install a tee above each working station, with the branch of the tee upwards. Install plugged tees at intervals so future drops or main line branches may be connected without cutting the line.

Drain line regularly, or operate with drains cracked very slightly.

Air Circuit Installations

Come off the branch of the tee with a wide pattern return bend. Coming off the top of the header insures that no moisture will flow into the drop.

Use pipe of adequate size. If 1-in. ID pipe is used for the main air supply line, ¾-in. will be large enough for a station of several air cylinders.

Install a trap and drain at the bottom of the drop. Locate conveniently and drain regularly.

It may be convenient to install a valve of adequate size so the station may be shut off.

Install an adequately dimensioned filter. If it picks up one speck of rust or scale it will have paid for itself. Drain when transparent receiver shows moisture.

Regulate air pressure at the station to insure proper operation. Regulation here provides flexibility and is less expensive than regulation of the total air supply at compressor outlet. Check periodically to see that operators are using proper working pressures.

Locate automatic lubricator in the line. Make sure it does not restrict the line excessively. Use unit with transparent bowl so oil level will be visible. Check operation of oiler and its oil level regularly.

rust, and pipe scale may be picked up by the air passing through the pipes. These particles of foreign matter can clog lines and impair operation.

Finally, air valves, cylinders and tools should be lubricated to insure optimum performance and life. The most efficient means of lubricating air components is through the air supply itself.

• **Air compressor**—Quite literally the heart of the utility air system, the air compressor draws in air, compresses it to useful pressures, and delivers it to the supply system. Obviously the unit should be capable of supplying both present and expected future needs.

• **Main supply line**—This line, or header, distributes compressed air throughout the working area. Drops from it carry air to the working equipment. The main supply line should be large enough to prevent excessive pressure drop due to surge. Pipe should be at least as large as the receiver outlet and large enough to handle four times the maximum normal air requirements. Adequately sized pipe costs very little more than smaller pipe, since installation cost is the major expense.

A looped main air supply line is recommended wherever possible, since it minimizes pressure drop throughout the system, and the air pressure will be equal at all points within the loop. In the dead-end systems, the farther a cylinder is from the compressor, the lower the air pressure available to run it. ▼▼▼

129 Hydraulic Pump and Motor Combinations

Here are power sources for any hydraulic application. Commercial, military, and aviation research have developed this array of standard pump and motor combinations.

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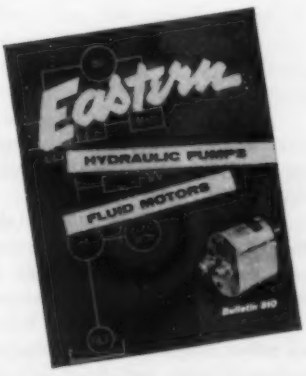

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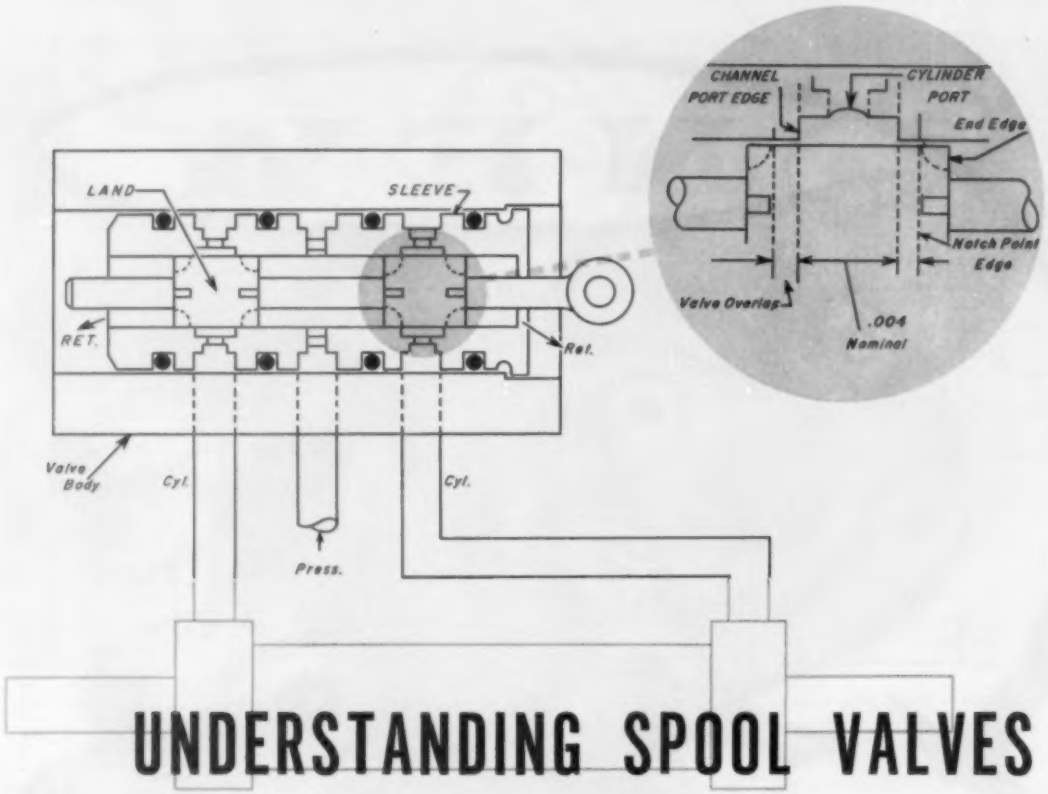


UNDERSTANDING SPOOL VALVES

HYDRAULICS BASIC ARTICLE

Knowing what goes on inside is a big factor in being able to select the best valve for the job. Here's basic information on metering, overlap, and stability.

● By Robert Spurr

Functional Procedures, Canadair Ltd, Montreal, Canada

SPOOL and sleeve valves have been in hydraulic control service for many years. Sometimes these valves are made without graduation of metering ability. In such cases, the land ends provide direct porting, and these valves can be expected to act abruptly. Much greater refinement of operation is obtained by use of notched, tapered, or flatted ends on the lands. The notched kind is described in this article, as it is perhaps the most complicated, and acquaintance with it will surely create easier understanding of all types.

The slide valve shown above has two lands rigidly connected by a stem. Each land is located in the bore of the sleeve to close off one port arranged as a circumferential channel in the sleeve. These lands are precisely located relative to the sleeve channels, so equal phasing is maintained at all positions.

System pressure is held in the middle of the sleeve bore between the two lands. The channel ports are connected through lines to each side of the actuator piston, and the portions of the sleeve bore outside the lands are open to return. When the spool is moved either way, the inner edge of one land opens a channel port, and fluid acts on one side of the actuator piston to force in or out. Since the lands are equally phased, the other channel port has been opened to return by the outer edge of the other land, and fluid from the un-

pressured side of the actuator piston is permitted to return. The IN port and OUT ports are open a like amount, and flow rate through each port is substantially uniform. This, of course, is only true with a double rod end cylinder with equal rod diameter. The opposite edges of the two lands are closely engaged across the inactive edges of the channel ports, so pressure is held securely in the middle of the sleeve bore and through the pressurized port.

• **Shut-off position**—To act as closing valves, each land must straddle its respective channel port. Length of land in excess of the channel port width is called overlap. Complete closing, however, is not desirable and is never achieved. The spool and sleeve are fitted together with sufficient clearance to obtain a fixed leakage rate at neutral—usually 40 to 150 cc's per minute.

This leakage insures that the valve parts are never dry. This prevents sticking, and helps avoid shock and violent action often associated with positive shut-off valves. Because of the fitted leakage rate, when the valve is shut-off, system pressure is not totally contained between the two lands of the spool, but acts on each side of the actuator piston. However, since the fitted leakage rate is also occurring across the outer edges of the lands, the system pressure acting on each side of the actuator piston is limited and is usually 1000 to 2000 psi, when system pressure is 3000 psi. This insures positive holding for the actuator, and minimizes the possibility of inadvertent actuator movement should slight loss of fluid occur in the actuator, on either side of the piston.

• **Flow position**—Notches formed at the land ends of the spool valves, modify the abrupt operation of a normal slide valve. When the valve is moved until the notches come open across the edge of the channel ports, the flow rate increases gradually with valve travel, and a graduated rate of acceleration is imparted to the actuator and the control surface. Conversely, when the valve is returning to neutral, shut-off is also achieved gradually. Full flow value of the valve is reached with only a small travel of the spool. The spool and sleeve valve is like a group of four, fast-acting needle valves, working in precise relationship—two opening and two closing.

• **Overlap**—If the spool lands had no notches, the effective valve opening would be the edges of the lands. That is, the valve would have to be moved until the land edge moved across the edge of the channel port before significant porting was achieved. The neutral leakage rate would, however, increase as the land traveled out of true neutral, because of the change in orifice, or "line loss" effect. In the un-notched case then, the valve overlap is the length of land in excess of the channel port width.

In the notched land, porting of the valve is achieved when the spool is moved far enough out of neutral to open the points of one group of notches across the edge of a channel port. Therefore, the overlap of the notched land is the distance between the inner points of the two groups of notches on one land, in excess of its channel port width. Half of this total overlap is absorbed in movement of the valve from hydraulic neutral (center of overlap) to a notched position.

Overlap imparts stability to the valve, and creates a certain amount of desirable lag in the system. A "dead band", although small, exists at the valve center, and a small portion of the valve movement each side of true neutral will occur with no change in pressure at the cylinder channel ports. Too much overlap might increase the control lag beyond desirability. Too little overlap would rob the valve of stability, and make the valve unable to resist or absorb vibration tendencies.

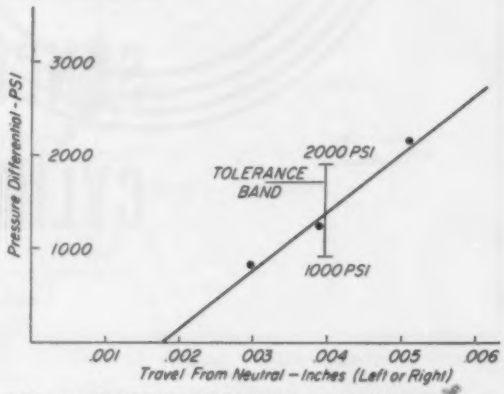


FIG. 1. TYPICAL PRESSURE DIFFERENTIAL as valve is moved from neutral. The tolerance band shown is a test specification for an aircraft flight control valve.

• **Testing overlap**—With system pressure admitted to the valve center, and a pressure gauge connected to each channel port, if the spool is moved out of neutral until porting is achieved, full pressure differential will register on the channel port gages—zero psi on one, 3000 psi on the other.

Using the same set-up, when the valve is placed at neutral, equal pressures, or no differential, will show on the channel port gages. Therefore, the channel port pressures pass from no differential at neutral, to full differential at the point of valve travel where the overlap has been absorbed and porting begins.

When overlap is correct, pressure differential between the channel port gages should be approximately the same for a given travel within the overlap range, each side of neutral, and should be approximately the same from one valve to another, Figure 1.

• **Testing flow**—Correctness of the valve for flow requirements is tested by moving the spool beyond the area where pressure differential is effective, and measuring the flow rate across a given

Concluded on page 111

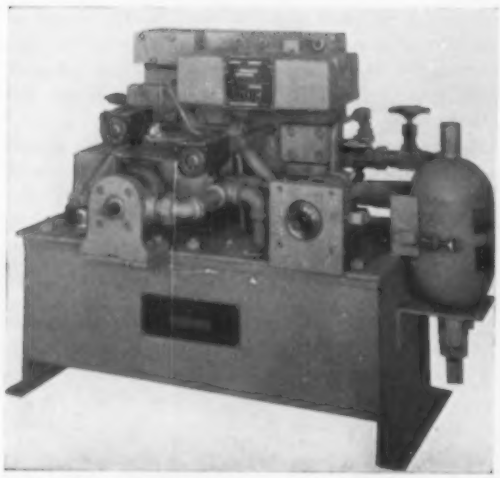
Accurate synchronization of machine motions is essential in a variety of applications Here's a simple but accurate way of . . .

SYNCHRONIZING CYLINDER RECIPROCATION

. . . with shaft rotation

• By Addison T. Smith

Partner, The Airoyal Co.
Maplewood, N. J.



POWER UNIT for high-speed hydraulic traverse and transfer incorporates two pumps, tank, accumulator and the necessary valves. Only component of the hydraulic system not incorporated in this unit is the traverse and shifting cylinder.

CONTINUOUS wire spooling requires a reciprocating traveller to guide the wire onto the spool in uniform, even layers. If wire speed is constant, the spool rotational speed must decrease as the layers build up, because diameter on which the wire is being wound is increasing. At the same time, and in perfect synchronization, traverse speed must decrease because it takes longer to make each wrap. An additional requirement is for the wire guide to be quickly moved to the location of the empty spool as soon as a spool is filled.

• **Hydraulic Circuit**—The wire guide is moved back and forth by a double-ended cylinder, controlled by a solenoid-controlled, pilot-operated 4-way valve, Figure 1. Solenoids are actuated by limit switches which are contacted by the wire guide at the ends of the required travel and by a wire footage counter.

Rate of traverse is controlled in two ways. Manual control of the variable-volume pump is used to compensate for different wire sizes. This, of course, requires adjustment only when the machine is being set up to handle a different size wire. But traverse speed must be continuously adjusted while the machine is running since as the layers of wire build up, more wire is required to complete a layer. Since the lineal speed of the wire is constant, tra-

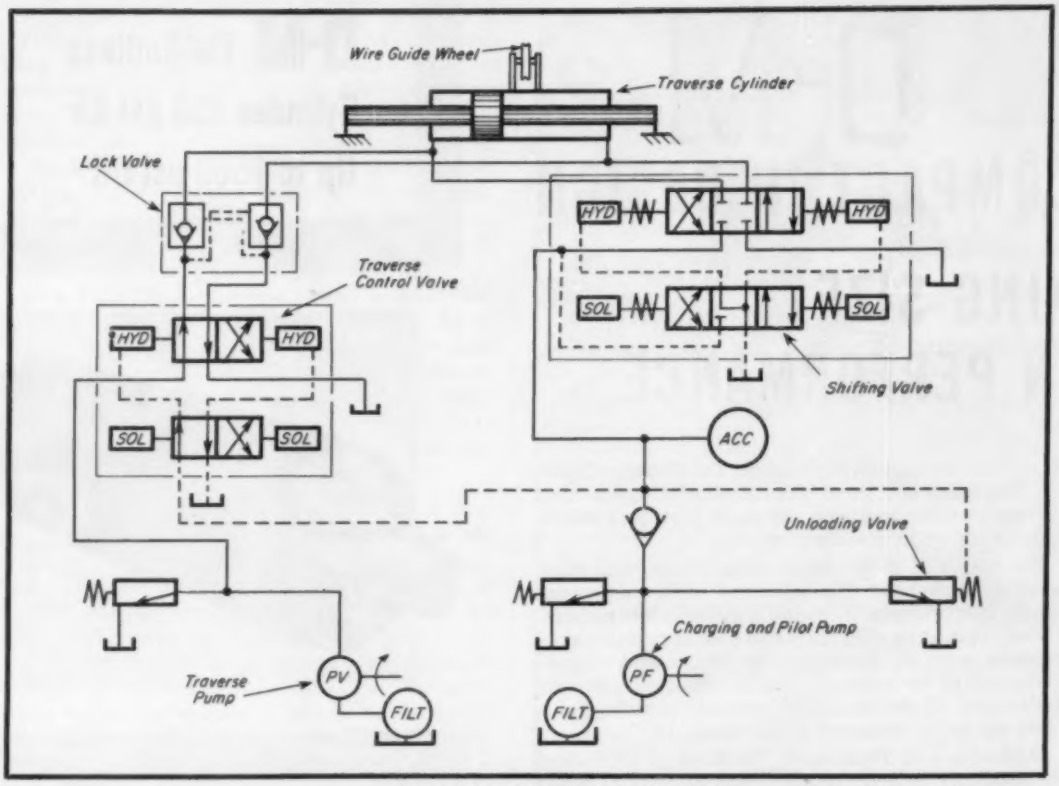


FIG. 1. HYDRAULIC CIRCUIT diagram of the high-speed traverse and transfer circuit.

verse speed must decrease. Speed of spool rotation must also decrease for the same reason. On this machine an adjustable-speed electric motor is used to provide spool speed variation. By driving the traverse pump from the same shaft, automatic variation in traverse speed is obtained with no additional hydraulic circuitry.

Charging and pilot pump is in the circuit for two reasons. If feed pump output were used to supply pilot pressure for shifting the traverse valve, there would be a momentary decrease in volume directed to the cylinder. Although small, this decrease is sufficient to cause momentary hesitation of the cylinder during reversal. At the speeds at which the machine operates this is sufficient to cause piling up of the wire at the flanges of the spool.

Second function of the charging and pilot pump is charging the accumulator which supplies fluid

Concluded on page 111

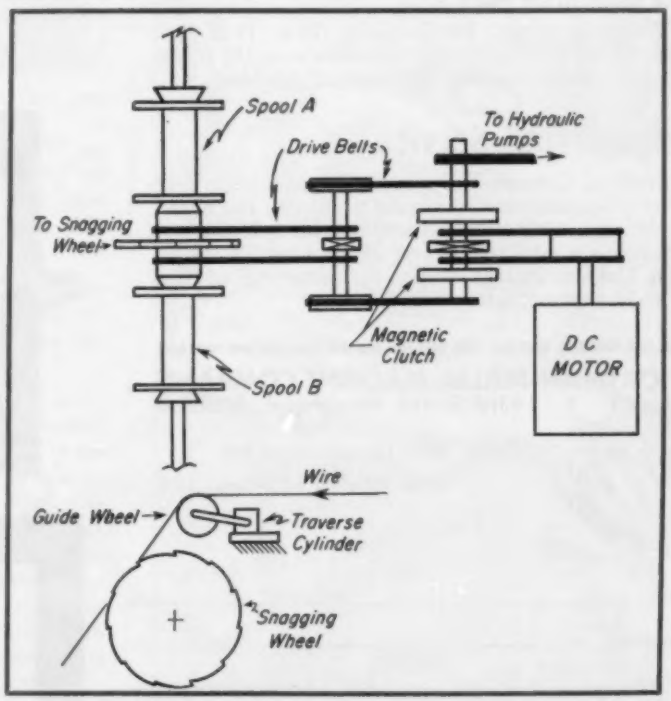


FIG. 2. ARRANGEMENT OF SPOOLS, spool drive and snagging wheel.

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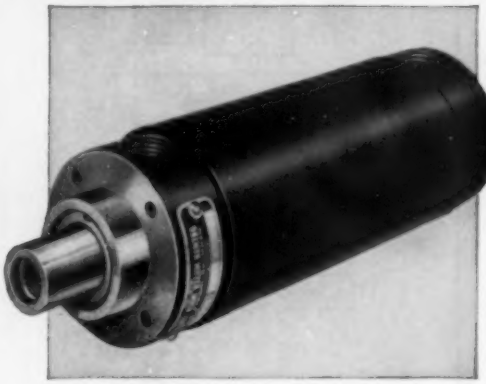

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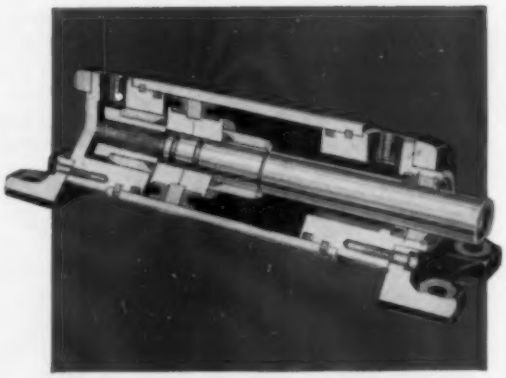


Fits Where Others Won't!

SYNCHRONIZING CYLINDER RECIPROCATION

for rapid transfer to the location of the next spool when one is completely filled. An accumulator is used because a very high flow rate is required for a short time interval to perform this shift. Use of this pump also allows the traverse pump to operate at the low pressure required for traversing while making higher pressure available for the shift. Time allowed for the shift is 0.1 sec. This holds the length of wire delivered during the shift to 5 ft with the machine operating at top speed.

Lock valve in the traverse circuit is two pilot-operated check valves. Their purpose is to block flow from the traverse pump during shifting. This was necessary because the cylinder might be traversing in the direction opposite the shift direction at the time the shift was initiated. Traverse pump flow would then have opposed shift flow and slowed the cycle down.

• **Mechanical Functioning**—As shown in Figure 2, two spools and the hydraulic pumps are driven by the single variable-speed, dc motor. Magnetic clutches are used to disconnect the drive from the full spool so that it may be unloaded and an other empty spool put in place.

While the wire is being wound on a spool, a footage counter continuously measures the wire. When the correct amount of wire is on the spool, the counter energizes the magnetic clutch, driving the empty spool to bring it up to speed. After a short time delay, the shifting valve solenoid is energized to traverse cylinder and wire guide wheel to the empty spool. As the wire is pulled across the toothed snagging wheel, the wheel catches the wire, cuts it, and pulls it in against the flange of the empty spool where it is caught by a notch in the flange. Winding at high traverse speed then proceeds on the empty spool.

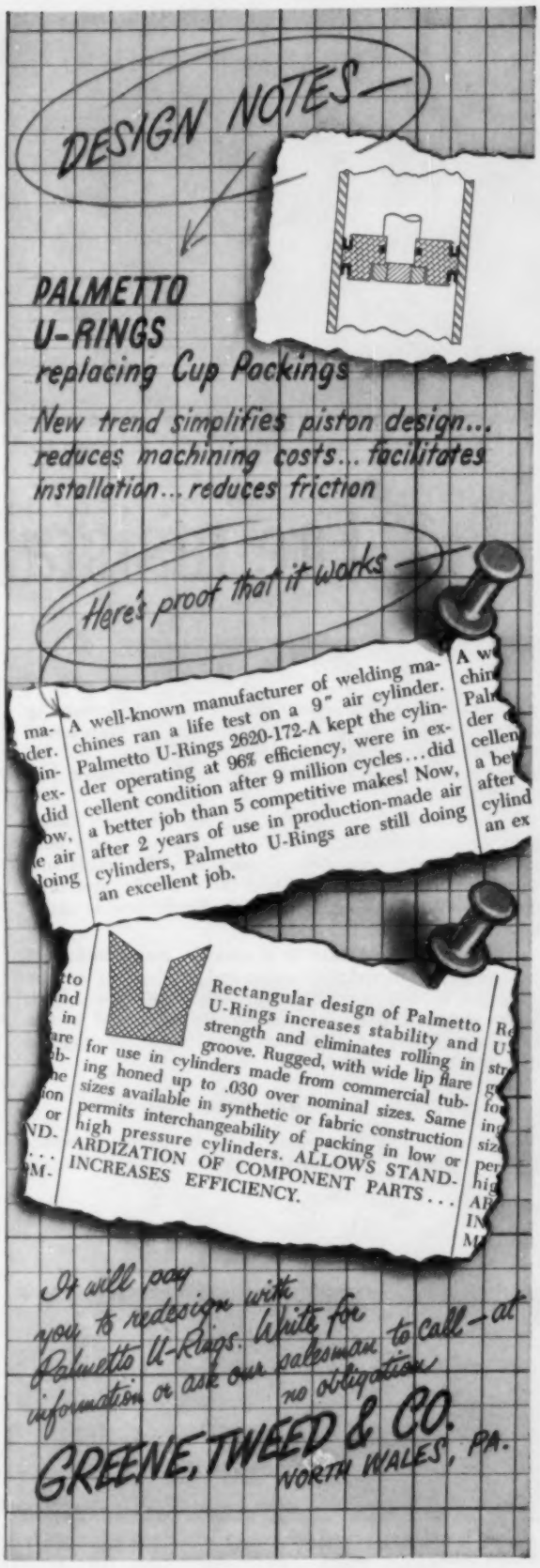
This entire sequence occurs in about 1/10 sec. During this time the hydraulic system goes from minimum traverse speed on the full spool to maximum on the empty spool. ▼▼▼

UNDERSTANDING SPOOL VALVES

Concluded from page 107

port, at stated travels, usually .030, .050, and .090 inches, or as desired.

• **Valve characteristics**—The Spool and sleeve valve is substantially closed and non-reversible when in the neutral or shut-off position. It is not totally closed because of the fitted leakage rate. At neutral it should be easy to position the spool in the sleeve at dead center at the point where equal, steady, pressure is obtained at both channel ports. If the neutral pressure is too high, the sleeve bore may have become "barrel" shaped, or rarely, the spool lands are too widely spaced relative to the channel ports. Conversely, if neutral pressure is too low, the sleeve bore may be "bell-mouthed" or the lands are relatively too closely spaced. Neutral leakage should be roughly equal from each end of the valve. ▼▼▼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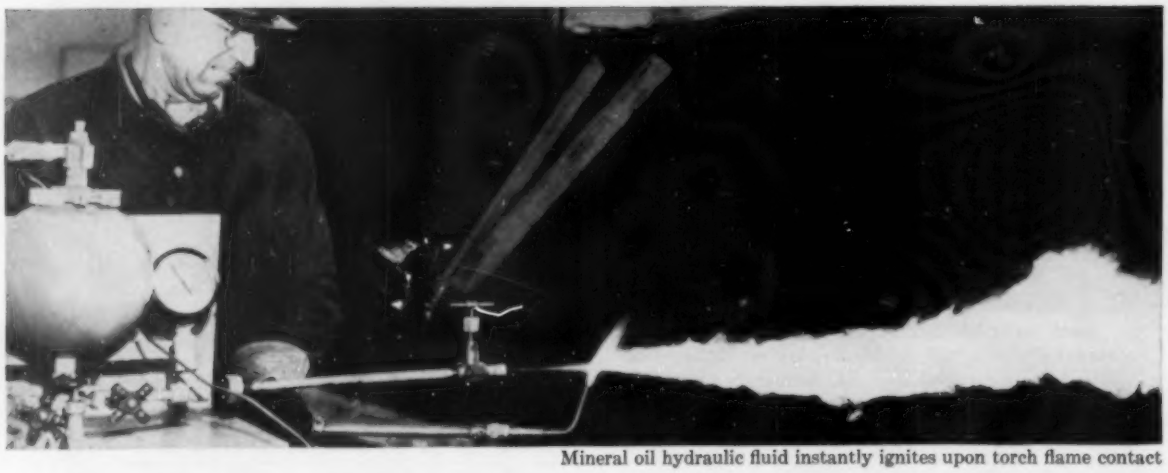


Mineral oil hydraulic fluid instantly ignites upon torch flame contact

Fire resistance plus low cost

FOR MANY YEARS frequent industrial fires involving hydraulic fluids have taken their toll in man-hours and high costs. This has created a widespread need for a relatively inexpensive all-purpose, fire-resistant hydraulic fluid.

In undertaking this challenge, Shell Research Laboratories spent over four years in laboratory and field testing before a solution was reached. The result was the introduction of Irus* Fluid 902 . . . the first low-cost, oil-base fluid that, under plant conditions, actually snuffs out fire.

The new formulation is a specific combination of petroleum oils mixed with water and emulsifying agents. It gains its fire resistance through a relatively high water content. Irus Fluid is perfectly adapted to the majority of hydraulic systems. The following is typical of many reports in Shell files.

Typical Problem and Solution

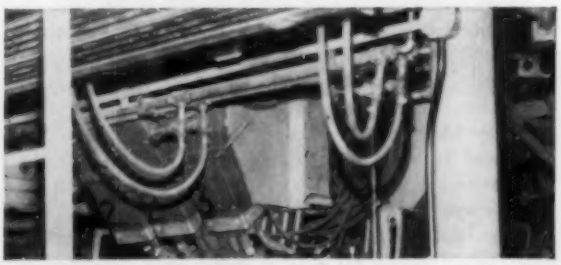
The welding plant of a prominent automotive manufacturer employing 100 hydraulically operated electric welders formerly used a straight mineral oil fluid. On one occasion, damaged fluid lines allowed this mineral oil under high pressure to spray directly onto the welding area. Sparks ignited the fluid . . . caused an immediate flash fire which resulted in 75% machinery damage before it was extinguished. Immediately following this incident, the changeover was made to Shell Irus Fluid 902. Shortly thereafter a line broke and the high-pressure spray once more contacted welding sparks. There was no fire at all . . . and in a matter of minutes the machinery was operating at full efficiency.

The two photos above provide dramatic proof of its flame resistance. In the photo on the left, conventional hydraulic fluid instantly ignites upon contact with an oxy-acetylene torch flame, whereas Shell Irus Fluid 902 (right photo), under the same conditions, does not support combustion beyond an inch or two from the flame. *Under plant conditions, it actually snuffs out fire!*

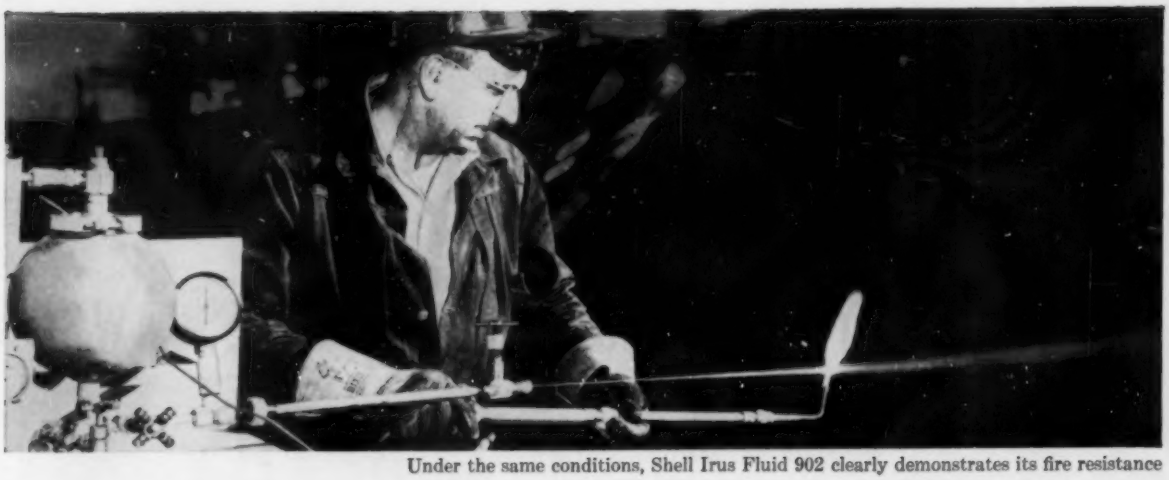
Two-Way Economy

An advantage not to be overlooked is the low cost of Irus Fluid 902. Many plant operators now making the

A leak is quickly spotted because of Irus Fluid's distinctive yellow color.



The complexity of cable lines necessitates the use of a fire-resistant hydraulic fluid to eliminate fire hazard.



Under the same conditions, Shell Irus Fluid 902 clearly demonstrates its fire resistance

in a new hydraulic fluid

switch to Irus Fluid find that it costs up to one-third less than other fire-resistant fluids—and its performance is comparable in every practical respect. This money-saving advantage is a vital consideration not only in the initial purchase price, but in reducing make-up loss expense.

Irus Fluid 902 has other features, too:

1. **It contains no corrosive ingredients and has shown no harmful effects on normal seals, fittings, or bearings . . . it will not promote rust.**
2. **No major equipment modification is necessary . . . simply clean your present fluid thoroughly from the system and replace with Irus Fluid.**
3. **Practical application proves it has exceptional viscosity and lubricating qualities . . . doesn't thin out in use.**
4. **The yellow color of Irus Fluid enables you to spot and trace leaks easily . . . a valuable benefit in preventive maintenance.**

If your operation utilizes die-casting machines, plastic molding machines, glass blowing machines, permanent mold machines or any other hydraulic equipment where fire hazards are of concern, we suggest you investigate the advantages of Shell Irus Fluid 902.

Write or call the Shell Oil Company office nearest you.

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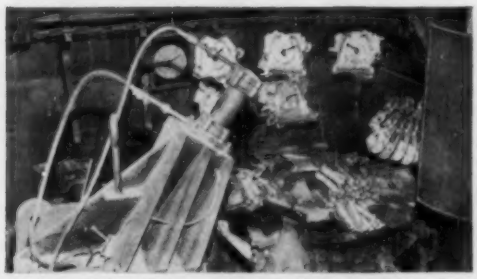
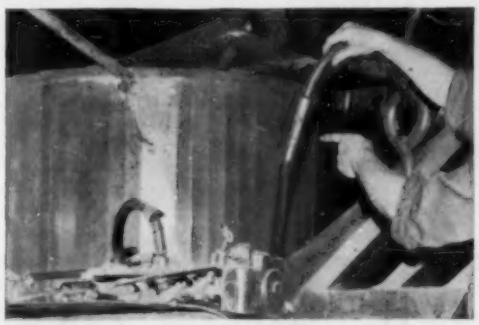


Such specialized die-casting machines require a fire-resistant hydraulic fluid to assure maximum safety.



Finger points to line break in hydraulic cable that caused flash fire and machinery damage while operating with mineral oil type fluid.

SHELL OIL COMPANY

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SHELL

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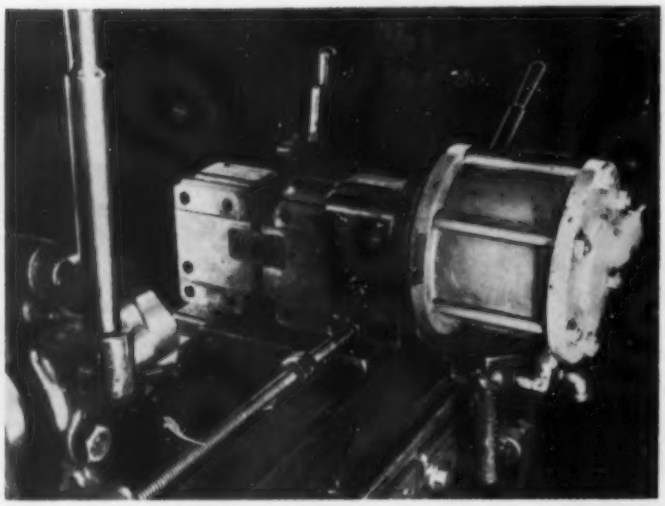
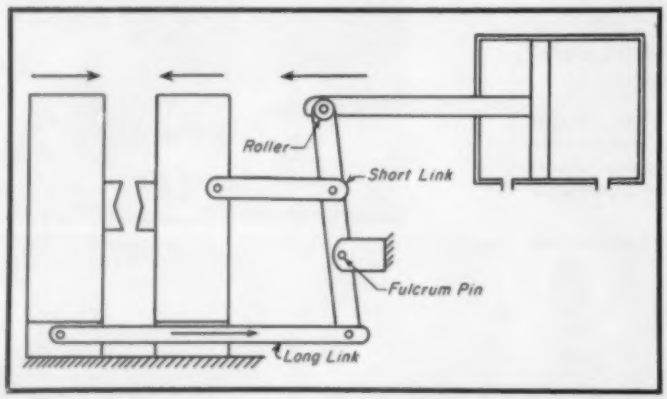
To provide a compact holding device adapted for modern high speed automatic or semi-automatic operation, both jaws of this vise are actuated by a single, double-acting air or oil cylinder, operating through a lever-and-link system.

SINGLE CYLINDER CONTROLS VISE JAWS

• By John R. Stottlemyer
Landis Machine Co. Waynesboro, Pa.



LEVER-LINK SYSTEM, powered by air cylinder, makes a compact, efficient package. Workpiece is always centered accurately, regardless of variance in diameter of the blanks.



ACTION of the vise is simple and precise. Thrust of the cylinder is transmitted in one direction through the shorter, top link, and simultaneously in the other direction by the lever through the longer, bottom link.

STANDARD units with movable, opposed jaws were too slow and unsuited for power operation. An air or hydraulic cylinder coupled to the parallel link system used by Landis Machine Co., moves both jaws toward or away from each other equally, simultaneously and swiftly.

Movement of the vise jaws can be adjusted accurately without affecting the position of the axis of the workpiece. Regardless of size, the center of the workpiece is held accurately and firmly at the same position when the jaws are closed. This feature is especially useful on forged or rough blanks, which are threaded or hollow milled without previous machining operations.

• **Actuation**—The mechanism used to operate the jaws of the new vise consists of a lever with fulcrum pin attached to the vise frame. One sliding jaw is attached to the lever a fixed distance above the fulcrum by means of a short link. The second, or opposed sliding jaw is attached to the lever an equal distance below the fulcrum by means of a long link, which reaches through the adjacent jaw.

When the lever is operated by the double-acting cylinder, the linkage gives practically equal movement, in opposite directions, to the two laterally moving sliding jaws, which are retained by gibs in a vise frame.

A U-shaped yoke is attached to the piston rod, which is coupled to a roller mounted at the top end of the lever, transferring the straight line motion of the rod to the arc motion of the lever. ▼▼▼

This pump manufacturer reports 25% savings with J&L COLD DRAWN ELECTRICWELD TUBING

Operator is threading 1¾" O.D. x 1½" I.D. J&L special smooth *cold drawn* Electricweld tubing for pump cylinder.

Low original cost and elimination of interior honing are two reasons why it pays you to specify J&L *cold drawn* Electricweld tubing with special smooth I.D. finish.

This manufacturer of oil well insert pumps reports a saving of 25% by converting from honed seamless tubing to *cold drawn* special smooth I.D. Electricweld tubing. Not a single tube failure has been reported from the field.

Because of its superior inside surface finish, exact tolerances and closely controlled physical characteristics, J&L *cold drawn* Electricweld tubing is recommended for these applications:

- *cylinder tubing*
- *shock absorbers*
- *ordnance parts*
- *hydraulic and pressure tubing*

J&L *cold drawn* Electricweld tubing is readily available in diameters from ¾" O.D. to 4¼" O.D., 8 gage to 20 gage, and can be furnished to closer than commercial tolerances. Write to Jones & Laughlin, 3 Gateway Center, Pittsburgh 30, Pa.

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STEEL ... a great name in steel

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FIRE-RESISTANT HYDRAULIC FLUIDS

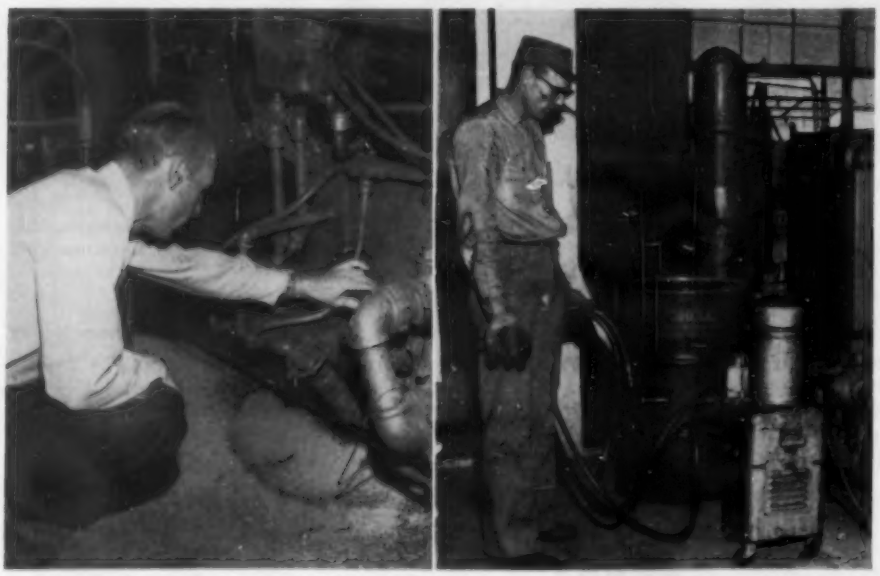
PART 6—Safety and Use Factors

• By Lawrence Jackson,
Plant Superintendent,
Withrow Die Casting Co.
N. Hollywood, Calif.

PETROLEUM oils perform well as hydraulic fluids in non-hazardous installations. However, these oils become fire-hazards if exposed to such ignition sources as molten metal, hot metal surfaces, open flames, sparks, and arcing electrical equipment. Resulting damage from fires can be serious and costly, since the oils support combustion.

When Withrow Die Casting Company decided to switch over to a fire-resistant hydraulic fluid, we were primarily concerned with the safety of the workers, plant and equipment, but economy was also a factor. For these reasons we selected Irus Fluid 902.

• **Fluid**—Irus 902 is a water-based, emulsion-type, hydraulic fluid manufactured by the Shell Oil Company. In addition to its excellent properties as a fire snuffing fluid, it is also economical. It is unique in its ability to mix with water. A combination of petroleum hydraulic oils, water, and emulsifiers, it turns instantly into steam and vapor when exposed to



WITHOUT ALTERATION, eight die casting machines were converted from petroleum hydraulic fluid to fire-resistant fluid. Due to the distinctive color, the presence of small leaks is easily detected, and both filling and emptying of the machine is easily done with a small pumping unit.

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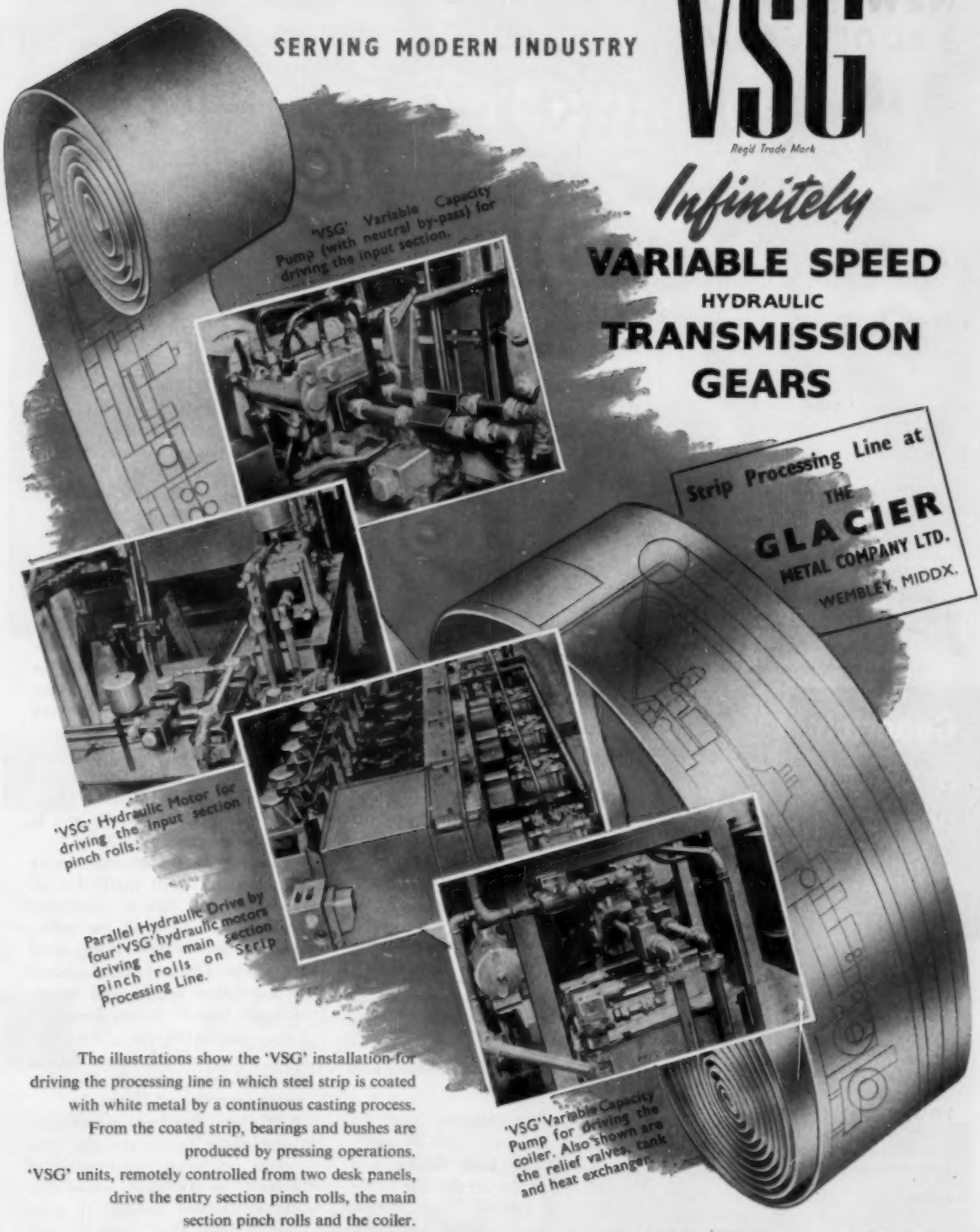
VARIABLE SPEED HYDRAULIC TRANSMISSION GEARS


'VSG' Variable Capacity Pump (with neutral by-pass) for driving the input section.
Strip Processing Line at THE GLACIER METAL COMPANY LTD. WEMBLEY, MIDDX.
'VSG' Hydraulic Motor for driving the input section pinch rolls.
Parallel Hydraulic Drive by four 'VSG' hydraulic motors driving the main section pinch rolls on Strip Processing Line.
'VSG' Variable Capacity Pump for driving the coiler. Also shown are the relief valves, tank and heat exchanger.

The illustrations show the 'VSG' installation for driving the processing line in which steel strip is coated with white metal by a continuous casting process. From the coated strip, bearings and bushes are produced by pressing operations. 'VSG' units, remotely controlled from two desk panels, drive the entry section pinch rolls, the main section pinch rolls and the coiler.

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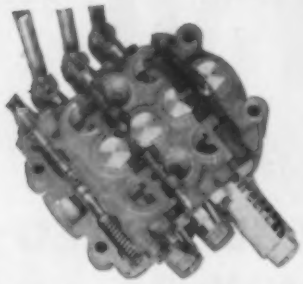
NEW HUSCO "3200" VALVE



- Choice of ONE to SIX plungers, with sealed ends—in completely balanced design.
- FOUR Control Positions—raise, lower, float, neutral—with or without detent.
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POWER TANK and pump combined into one unit for compactness and convenient location—right on your machines.

COMPACT SIZE for greater adaptability and wider application—install it . . . on the machine . . . next to it . . . or away from it.

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METAL MACHINING COMPANY
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any source of ignition, either in its liquid form, or in a high-pressure spray.

• **Safety**—All our die casting machines have been charged with this fluid during the past two years. Breaks in hoses, pipes, and fittings have caused no fires, no worker injuries, and no plant machinery damage. Two specific instances can be cited.

One line break discharged about 40 gallons of fluid onto a pot of molten aluminum. After the steam blew out, only a small, flickering flame remained, which was confined to the pot and died out quickly. On another machine, a hose connecting a hydraulic core pull severed, and fluid at 1000 psi sprayed out, drenching the operator and surrounding shop area. Because there was no danger of flammability, the operator was able to shut off the power supply and stop the flow of fluid. The machine was back in operation shortly after the defective hose had been replaced.

• **Changeover**—While switching from the conventional petroleum oil to the fire-resistant fluid was not difficult, care was taken to insure cleanliness and tightness of the hydraulic system. Proper installation of fluid and prevention of system contamination has resulted in trouble-free operation. The identical changeover procedure was followed for each of our eight die casting machines:

1. Drain out all of the mineral oil.
2. Use Irus as a flushing medium and run for 15 to 30 minutes.
3. Drain out and recharge with Irus. Run for one week.
4. Drain out and recharge with the fluid.

Due to the distinctive color, the presence of small leaks is easily detected, and both filling and emptying of the machine is easily done with a small 1/3-hp pumping unit.

Besides being easy to install, no new or special machine components were required, such as packings, O-rings, seals, etc. In fact, the machine worked better when we removed certain components. Screen-type filters on the suction lines were removed from the tank, and the fine filters on the intake to the pump. Fine oil purifiers were also taken out, since effective machine operation was possible without them.

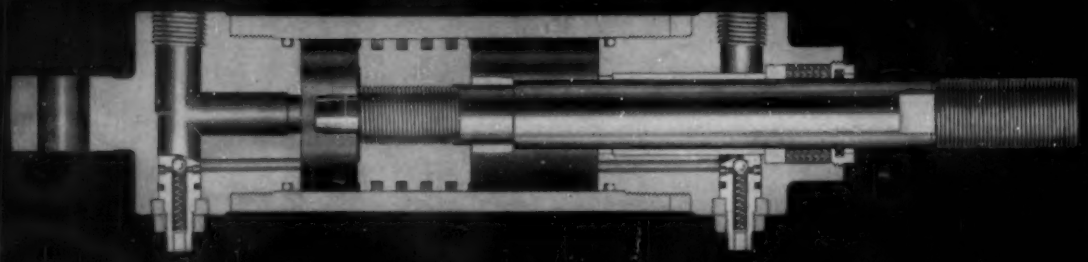
• **Leakage**—Equipment checks are made daily, but major problems are handled on week-ends when the plant is shut-down. Leaks are fixed, fittings are tightened, and the hoses replaced as necessary. The distinctively yellow color of Irus Fluid helped immeasurably in cutting down make-up losses. Leaks and seepage show up plainly, and the color of the fluid remains constant in operation. Make-up runs to about 70 gallons monthly for all machines, compared with nearly double that amount for mineral oil. Temperature of the fluid is 108 to 110 F, much cooler than formerly.

• **Wear**—The pumps we use are combination low and high pressure, double vane type. Some of the machines are equipped with 15-hp, 1000-psi pumps, while others have 25-hp, 2000-psi pumps. Only negligible wear was encountered in the high-pressure cartridge in the pumps, the inner face of the eccentric ring becoming uneven. This cartridge lasts about six to eight months and is replaced at a cost of $20.

Pump part replacement costs run to about $200 yearly for all machines, and this is considered negligible in light of the safety afforded by the fluid. Pump service life on some of the machines is better than others, and we attributed this to better design of the hydraulic circuits. There has been no wear whatever, during the past year, on our 48-gallon pump operating at 2000 psi.

• **Water replacement**—Because there is always the possibility of some evaporation of water from the fluid, water content is checked monthly. A solution of 50% fluid from the machine, and 50% acetone, is shaken in a tube and then allowed to settle out. Thus far, water content has remained stable at 35%, and we have yet to add any water. ▼▼▼

Proved in performance



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Performance Check List

1 Only Pathon offers a full line of Hydraulic Cylinders using a single screw thread to retain the cylinder head. You get extra compactness, low stress concentration, and greater resistance to shock loading.

2 Adequate space between the bearing points on all Pathon Hydraulic Cylinders result in:

(a) Increased bearing life. (b) Increased rod seal life. (c) Reduced power eating friction. (d) Provides a more rigid unit — eliminates rod cocking at the end of out stroke. (e) Eliminates need for internal spacers.

3 The single screw method of attaching the head to the cylinder results in extreme rigidity of the entire assembly. This combined with the absence of tie-rods makes cylinder with long strokes practical.

4 The head seal in all Pathon Cylinders is a true static seal and will give much longer life in operation.

103

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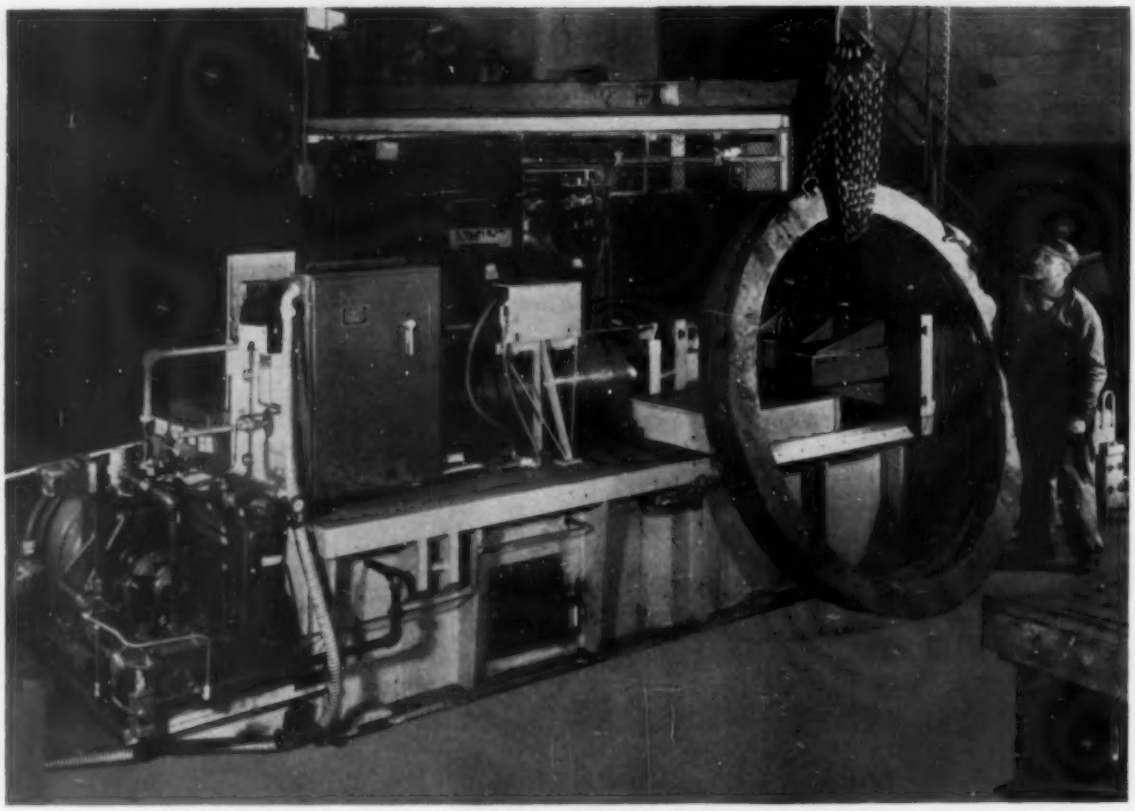
HYDRAULIC CYLINDERS AIR CYLINDERS HYDRAULIC DIRECTIONAL CONTROL VALVES



POWER UNIT to the left of the machine includes a 30-hp motor driving an 18-gpm pump. Reciprocating intensifier is shown in foreground. 100-gallon reservoir is built into base of machine. Two welded rings which have been bent for gears are shown.

TIMED DECOMPRESSION . . .

• By John Cullen and M. McAlpine

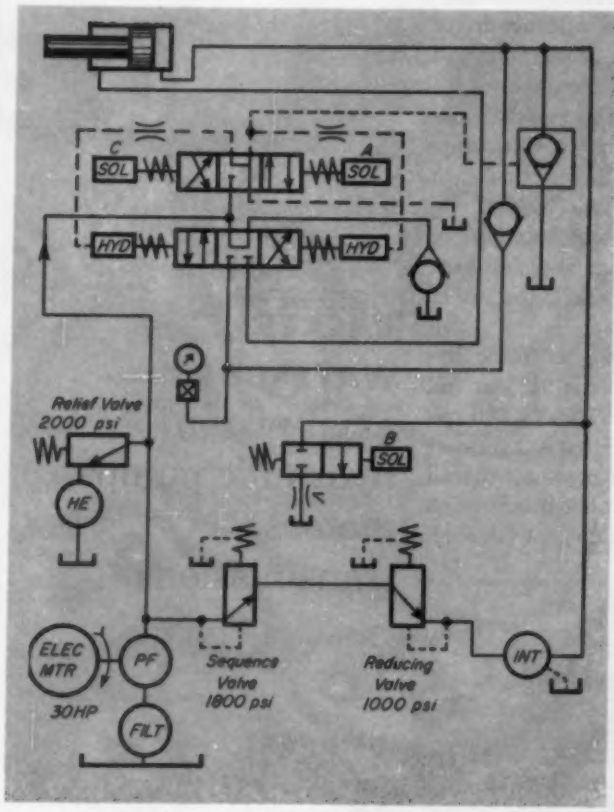
BECAUSE oil *is* compressible, and because of the stressing of machine members under high pressure, releasing a large amount of pressure fluid suddenly can set up high surges throughout the system. In decompressing a cylinder, a small amount of the high pressure fluid is allowed to leak off lowering the pressure to a safe point for reversal of the directional control valve.

In a heavy bending machine designed by McGregor-Michigan Corp. working with Hydraulic Specialties, Inc. the need for decompression was furthered by the type of work, as well as the design of the bender itself. The 600-ton horizontal forming press called a *bulldozer* is used for cold-forming heavy bars, channels, I-beams, and other structural shapes into accurate sections with bends to 360 degrees. The machine can bend a 4 x 6-inch bar to a radius of 30 inches for use as a gear blank.

The spring-back of a steel bar of this size adds to the decompression requirements for the system. With the 14-inch cylinder and a 72-inch stroke, 48 gallons of fluid are under compression with the cylinder completely extended.

Although the intensifier is rated at 5000 psi, it is actually operated at output pressures to 7500 psi. This requires a 1500-psi setting of the pressure reducing valve. The 2-stage, vane type pump is rated at 2000 psi. With a low pressure input to the intensifier of 24 gpm, the output from the unit is approximately 4.8 gpm.

JOHN CULLEN, *Chief Engineer, McGregor-Michigan Corp.*,
M. MCALPINE, *Hydraulic Specialties, Inc., Detroit, Mich.*



DRILLING A CHECK VALVE with an orifice of .035 inch is an effective way to decompress the large cylinder.

on a 600-ton bender

DECOMPRESSION DESIGN

In the original design of this machine, the decompression device was incorporated in the pilot-operated check valve which was drilled with a .035-inch drill to provide an orifice connecting the head end of the cylinder to tank. This arrangement required that the operator observe the gage to determine when decompression had progressed far enough to reverse the 4-way valve. This was done when pressure had dropped to about 1500 psi. The operator then pressed a pushbutton energizing solenoid *C* of the 4-way valve to retract the cylinder.

The original design has been modified to include a 2-way solenoid valve, variable orifice and timer. ▼▼▼

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For more than 100 years the name Ashcroft has stood for the most advanced pressure gauge research, design and engineering. By anticipating the constantly changing and expanding needs of all industrial users, we have combined in Ashcroft Gauges the highest degree of accuracy and long-life service for every type of installation. You can select dial sizes ranging from 2″ through 24″ . . . pressures from 30″ vacuum or a few ounces up to 100,000 psi . . . materials that meet all service demands.

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Among the many Ashcroft Gauges are Maxisafe®, pneumatic receiver, recording, chemical and special application gauges, plus a variety of gauge testers. Get all the facts. Learn why Ashcroft Gauges are the best investment you can make. *Write for Catalog 300.*

Quality Gauge No. 1010 for general applications.

Quality Gauge No. 1056 for hydraulic presses.

Quality Gauge No. 1000 for small equipment.

Special Purpose Gauge No. 1009. Heavy-geared.

Vibration-Resistant Gauge No. 1122. Heavy-duty gearless.

Duplex Gauge No. 1038 A. Indicates two pressures on dial.

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when you want

1 extremely fast acceleration and reversal

2 precise speed control

These axial-piston pumps and motors are particularly suitable for marine and ordnance drives where precise control of torque, acceleration and deceleration, speed or reversal are important.

The pump is a factory-assembled power package with built-in auxiliary pump (provides super charging, control pressure and forced circulation for cooling), replenishing and relief valves.

Transmissions are usually combinations of variable delivery pumps with axial-piston fixed displacement fluid motors. Peak output is at 3,000 psi from 45 to 3,600 hp.

Overall mechanical efficiency of these hydraulic pumps or motors exceeds 91% at full load; volumetric efficiency is 97% at 3,000 psi; torque efficiency, when used as a hydraulic motor, exceeds 95% at rated pressure; overall mechanical efficiency of a hydraulic transmission (pump and motor) can exceed 85% at full load.

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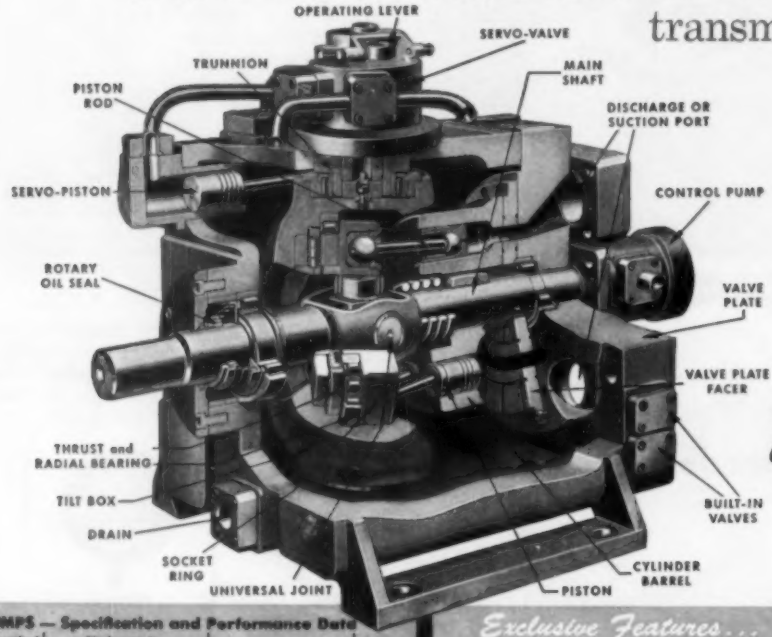

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HEAVY DUTY PUMPS — Specification and Performance Data

Heavy Duty Size	Rated Speed	Theoretical Maximum Displacement	Discharge in Gallons per Minute at Rated Speed* (Supercharged)			Horsepower Input*			Approx. Weight
	rpm	cu. in./rev.	1000 psi	2000 psi	3000 psi	1000 psi	2000 psi	3000 psi	lbs.
1¼A HD	1200	5.65	29.1	28.9	28.4	20	38	58	390
2½A HD	1200	11.3	58.4	57.8	56.9	40	76	112	450
5A HD	1200	22.6	117	116	114	79	152	224	620
10A HD	900	45.2	175	173	170	119	227	334	1100
15A HD	720	67.8	210	208	205	142	273	403	1600
20A HD	600	90.4	233	231	227	158	302	446	2000
35A HD	600	158.2	408	404	398	277	529	782	4900
50A HD	514	226	500	495	487	340	648	957	6600
75A HD	514	339	750	743	731	508	974	1437	9000
150A HD	450	678	1314	1301	1281	891	1706	2519	27000
300A HD	400	1356	2336	2313	2277	1585	3031	4478	43000

*3,000 psi tabulation is an intermittent rather than continuous duty rating, and is recommended only where the specific application and duty cycle have the approval of our engineering department.

Exclusive Features . . .

1. Largest capacity (up to 2,300 gpm) and highest horsepower (up to 4,000 hp) in the oil-hydraulic industry.
2. Fastest stroking . . . in less than .03 seconds, the Size 5 Heavy Duty Pump can go from zero to full delivery.
3. Ultrafine control . . . training and elevating of large gun turrets, missile launchers, etc., have been handled by axial-piston transmissions with exceptional accuracy at speeds controlled to 1 rpm.
4. Most compact unit for large capacity equipment . . . a 2,300-gpm pump occupies only a six-foot cube.
5. Extreme ruggedness and reliability with exceptionally long life . . . many axial-piston units have been in operation for 20 to 25 years, some without overhaul.
6. Very rapid acceleration and deceleration and reversals with remarkable smoothness.
7. Controls, valving and auxiliary pumps can be incorporated directly in, or on, the units.

MO-209

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DIVISION OF SPERRY RAND CORPORATION
Marine and Ordnance Department
WATERBURY 20, CONNECTICUT

Hydraulic Products for Marine and Ground Defense Applications

MODIFIED RELIEF VALVE

. . . solves automatic positioning problem

A basic problem in the design of a life test machine for automobile and truck springs is the set taken by the spring as the test progresses. To maintain constant spring loading during reciprocating cycling, a position follow-up method is needed.

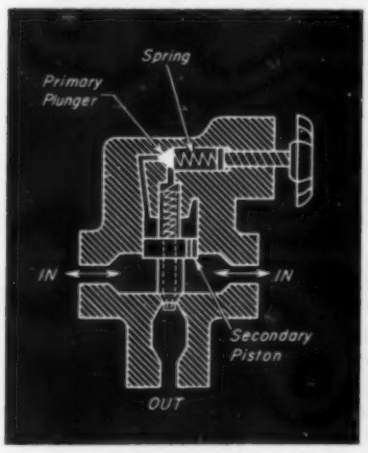
● By E. B. Porter

Supervisor R & D Design Section, Vickers Inc., Detroit, Mich.

LIFE testing a semi-elliptical automobile suspension spring would be simple if the spring did not take a permanent set while being tested. All that would be necessary would be to attach the spring eyes to a table and with a ram apply sufficient pressure to the center of the spring to deflect it through a distance equal to maximum deflection during actual operation. However, with the ram set for a fixed stroke, spring set would soon change the no-load position of the spring so that a portion of the ram stroke would not produce spring deflection. Readjustment of the ram position relative to the test table would, therefore, be required at intervals throughout the test.

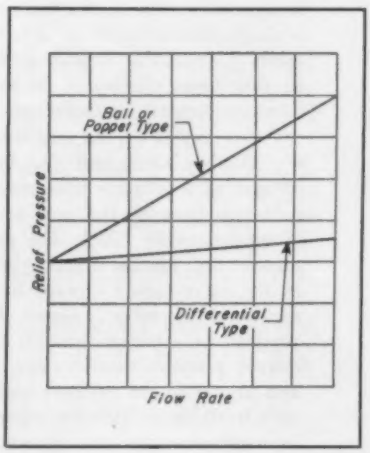
Obviously, some automatic system for repositioning the ram or the table will be a convenience and eliminate constant attention as well as stopping the test for adjustments. Additional, completely automatic adjustment will more nearly simulate actual operating conditions. A system using a modified relief valve as the position-sensing device and

A slightly modified version of the differential relief valve shown here serves as a position sensing device in a spring testing machine. In the standard relief valve, adjustment of spring compression in the primary section is performed manually with a handwheel on a threaded stem. Only modifications made to use the standard valve in this application were substitution of a smooth stem for the threaded stem and incorporation of a dashpot chamber, piston and connecting orifices. Purpose of the dashpot is to prevent the stem from being forced upward by the spring during upward movement of the reciprocating ram used on the spring test machine.



Relief valves of the differential type are used in hydraulic circuits because they give closer regulation of pressure with varying flow rates than do simpler valves. This is because the main plunger in the secondary section is operated by hydraulic pressure differential on the piston rather than by pressure working against a spring. A small orifice connects the cavity below the piston with the cavity above the piston. If the cavity above the piston is sealed, pressure on both sides of the piston is equal and the piston is held on its seat by a light spring. If pressure is bled from the cavity above the piston, flow pressure drop through the orifice reduces pressure on top of the piston and allows it to be forced upward and fluid passes directly to tank. Pressure is bled from the cavity above the piston by the small poppet-type relief valve in the upper portion of the valve. Spring holding this poppet closed is small and has a high rate. This valve never has to open more than a few thousandths of an inch, the cracking distance, to cause the main poppet to open fully.

In the simple spring-loaded ball or poppet-type relief valve, which is like the primary section of the differential type, a certain pressure causes the valve to just open or crack. At this opening, a certain flow can occur. For a higher flow rate, further compression of the spring is necessary. Relief pressure increases considerably between cracking and fully open position with this type of valve since considerable pressure increase is needed to fully compress the comparatively heavy spring.



MODIFIED PRESSURE-RELIEF VALVE

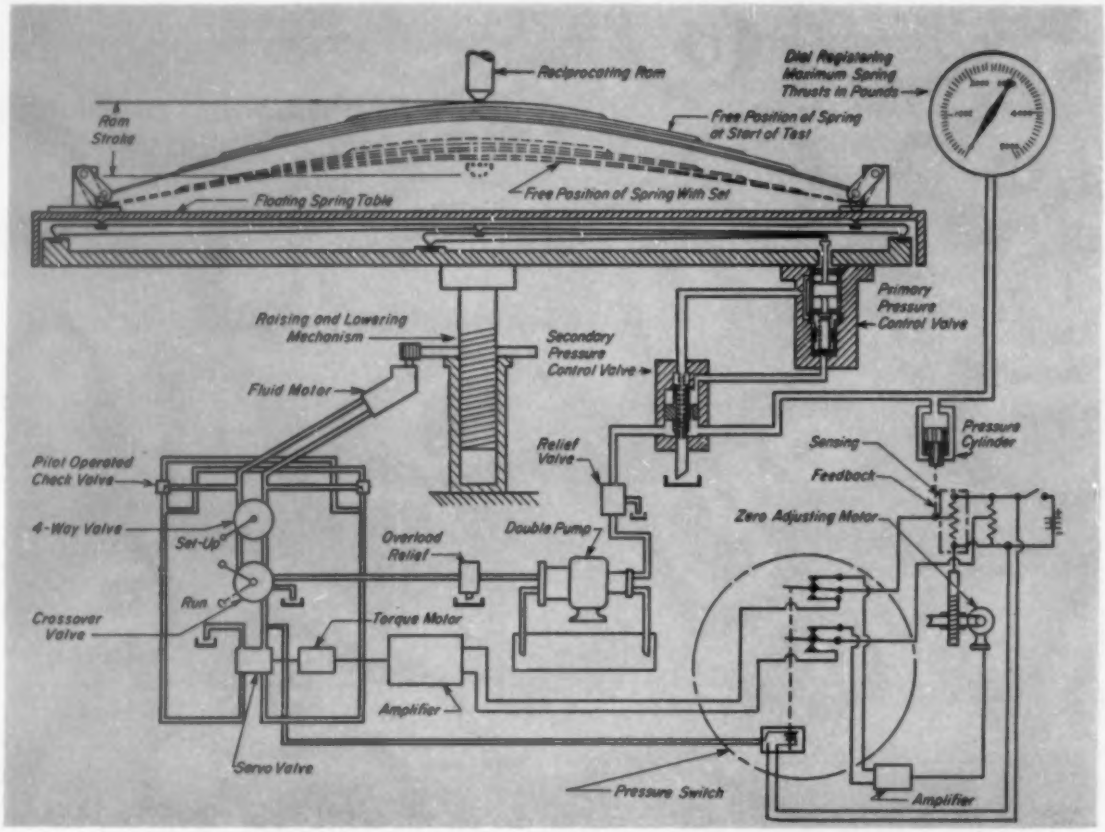


FIG. 1. SYSTEM FOR AUTOMATIC FOLLOW-UP as spring set changes free position of the spring. Both sensing system and positioning drive are hydraulic.

a hydraulic positioning drive has been developed to solve this problem.

• **Spring Testing System**—In this system, Figure 1, the reciprocating ram has a stroke equivalent to normal amplitude of a vehicle spring. The spring is shackled to supports on a table which floats on a beam system. The beam system is supported by another table which can be raised or lowered by some mechanical arrangement.

Force exerted by the ram is transformed through the floating table and the beam system to the plunger of a primary pressure-control valve. Force reduction between the ram and the valve plunger is approximately 100:1. The primary control-valve plunger acts against a spring which holds a poppet in the valve closed against hydraulic pressure. A section of the valve is shown in Figure 2. Fluid is supplied by a pump, through an orifice in the secondary pressure control valve. The plunger, spring and poppet in the primary control valve constitute an adjustable relief valve whose cracking pressure is determined by the amount of force exerted against the plunger and spring by the beam system of the table. Cracking of the primary control valve vents the chamber on the downstream side of the secondary pressure control valve piston, Figure 3. This allows pump pressure to force the piston of the secondary control valve upward and unseat its lower end. This returns oil directly to tank from the lower port of the secondary control valve to maintain pressure to the pressure cylinder and gage at a value proportional to compression of the spring in the primary pressure control valve. Calibration of the pressure gage is in terms of pounds of force exerted by the spring upon the table.

During the ram upstroke, spring compression in the primary pressure control valve is maintained by oil trapped in the dashpot chamber of this valve. A check valve in the dashpot piston and the small orifice leading from the chamber to the outlet port prevent oil escape during the upstroke. However, a gradual decrease in force applied to the upper end of the valve stem, such as

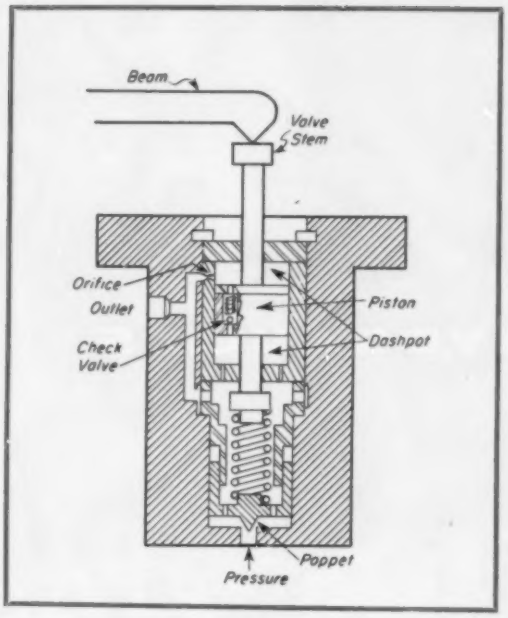


FIG. 2. PRIMARY CONTROL VALVE in the hydraulic sensing circuit.

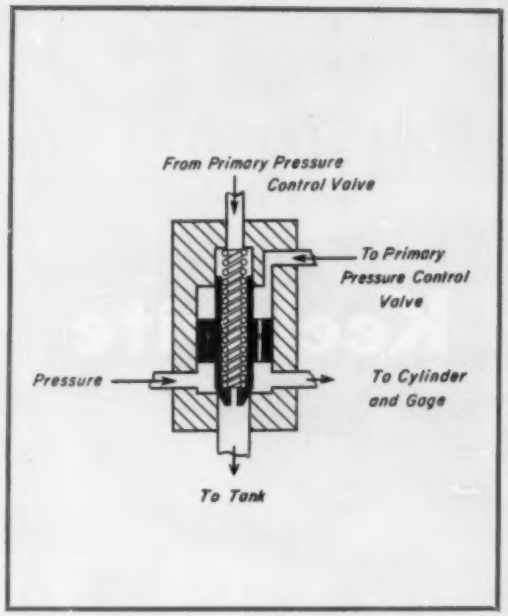


FIG. 3. SECONDARY PRESSURE-CONTROL VALVE used in the automatic spring test set-up.

results from the spring under test taking a set, permits oil to escape from the dashpot chamber gradually. This allows the piston and valve stem to move upward to whatever position is taken by the secondary beam of the scale as force upon the table diminishes.

Upward movement of the stem results in less compression of the spring loading the poppet. The poppet then opens at lower pressure and by the interaction of the primary and secondary pressure-control valves more of pump flow is returned to tank. This reduces pressure to the pressure cylinder and gage.

Lowered pressure in the cylinder lets the spring move the piston upward. The pressure cylinder is connected to a potentiometer which makes up two of the arms of a Wheatstone bridge which serves as the error sensing element. Resulting voltage is applied to an amplifier connected to a torque motor. The motor positions a servo valve spool controlling a fluid motor which moves the table to a position where displacement of the primary pressure control valve stem restores pressure and rebalances the bridge.

For setup, a manually-operated, four-way valve is used to position the table. During setup, the cross-over valve is placed in the "setup" position to direct output of the large section of the double pump to the manually-operated, four-way valve rather than to the servo valve. The pilot-operated check valves prevent any flow to the servo circuit from that side of the four-way valve.

Cutting off pressure from the servo valve during setup also removes pressure from a pressure switch to reconnect the error sensing bridge to a motor which positions the potentiometer portion of the bridge to keep it balanced. Application of pressure to the servo valve circuit causes the pressure switch to connect the bridge to the amplifier and torque motor controlling the servo valve. Bridge unbalance then causes repositioning of the table. ▼▼▼

Previous articles on hydraulic servo systems which have appeared in APPLIED HYDRAULICS are:

"Machine Tool Tracer Control," by A. E. MORRIS, Sept., 1955

"Servo System for Speed Control," by C. M. GEORGE, June, 1955

"Servo Valves Control Jet Engine Test," Sept., 1955

"Two Pump Metering Circuit Solves Costly Control Problems," by C. W. VOKAC, Dec., 1954

"Servo Controlled Power Cylinder Positions the Load," by WALTER C. CARRUTH, JR., Oct., 1954

"An Electro-Hydraulic Servo Pump," by N. WILLIAMS, March, 1954

"Hydraulic Control System for a Cam Milling Machine," by W. F. MORGAN, Nov., 1953

"Servomechanisms for Industry," by F. B. McLAREN, Sept., Oct., Nov., 1953

"Servo Control Valve Equalizes Bending Action," July, 1953

"Servo Valve Design for Autopilot Applications," by M. P. WOLPIN, July, 1953

"Tracer Circuit for Machining Guided Missile Parts," April, 1953

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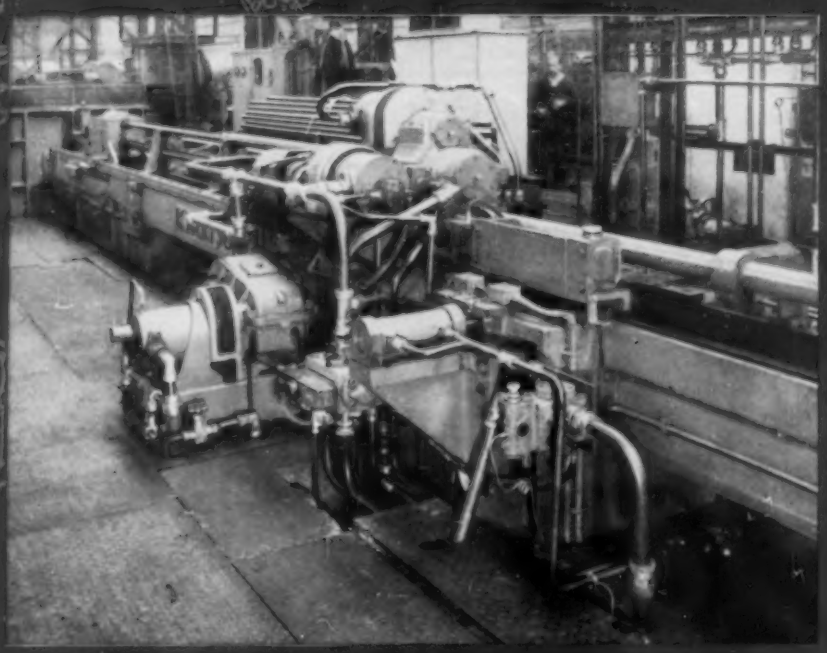

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AVIATION SECTION

Applied Hydraulics

NOVEMBER 1957

DESIGNING SERVO ACTUATORS FOR 700 to 1000 F 128

By G. R. Keller

Methods used to successfully design servo actuators for high ambient temperatures.

AIRCRAFT HOSE DEVELOPMENT
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By Irving D. Press

Solving the problem of a flexible hose to resist high temperature corrosion through use of Teflon interlayer.

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AVIATION COMPONENT DATA 140

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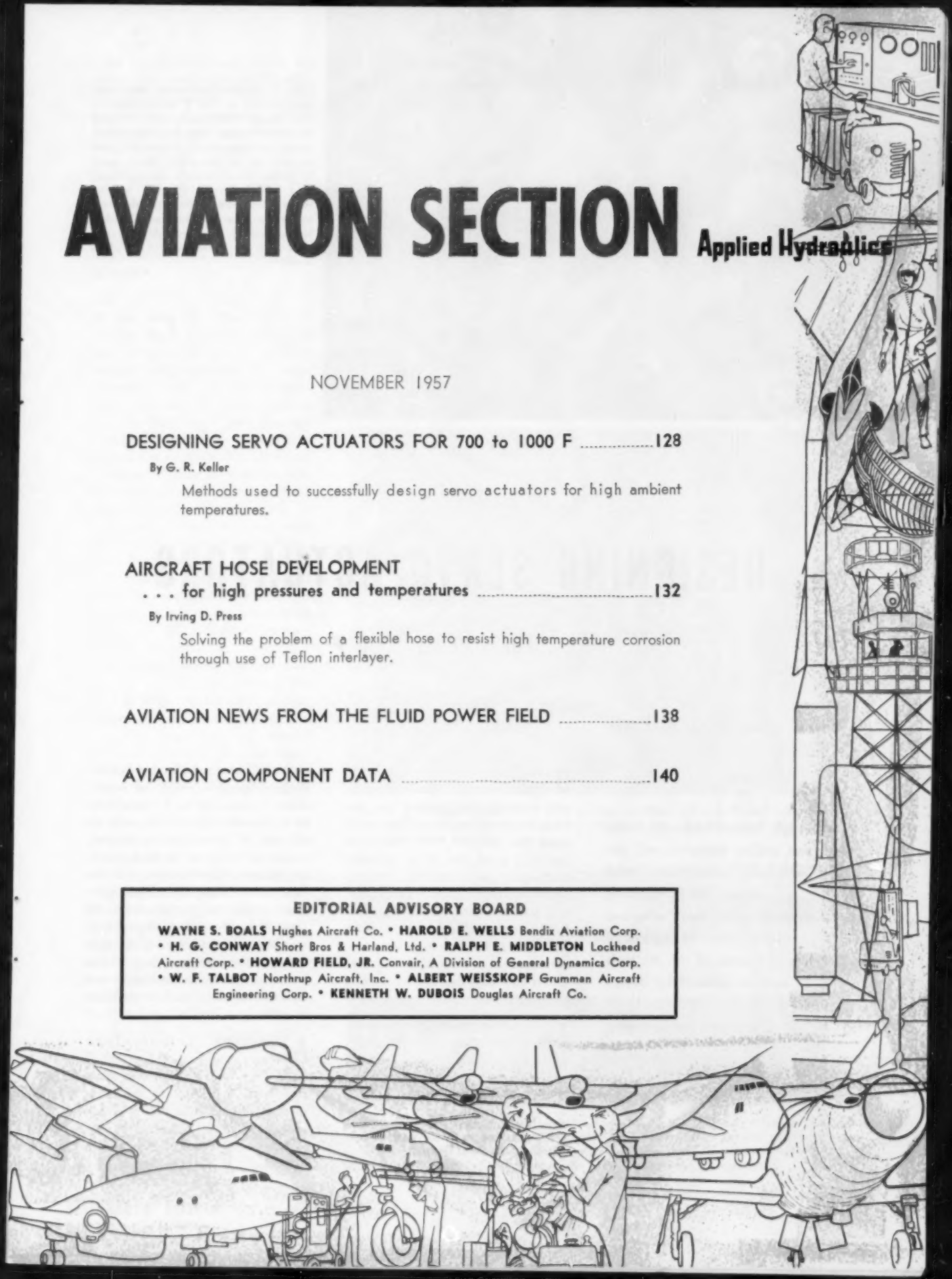

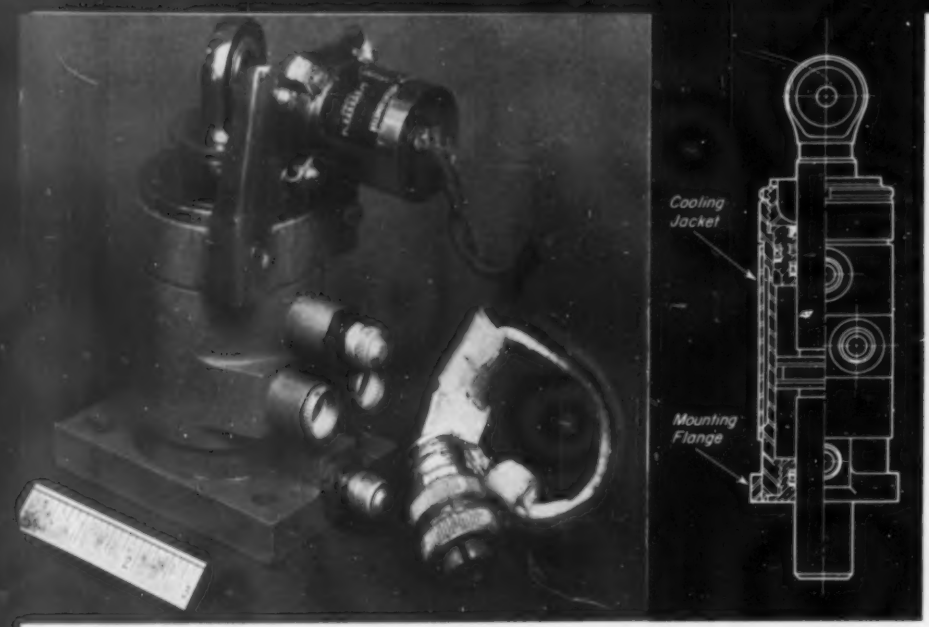

FIG. 1. Jacketed actuator performs successfully at 700 F temperatures. The short, rigid body and flanged mount eliminate any bending effect which might result from thermal expansion of the rigid lines used to make the hydraulic connections. Rod end connects directly to the control surface bellcrank through a rocker arm so that no flexible hose, swivels or other devices are necessary to provide for relative motion.

DESIGNING SERVO ACTUATORS

. . . for 700 to 1000 F

• By G. R. Keller

Although today's hydraulic fluids and sealing materials will not withstand temperatures much above 500 F, hydraulic servo actuators must withstand much higher temperatures. Here are some of the methods used to successfully design for 700 to 1000 F ambient temperatures.

DESIGN of a servo actuator or hydraulic cylinder for a modern airplane has become an extremely complex task. Not only must the actuator be a source of force, it must also be a dynamic component of a control system. Dynamic requirements often dictate packaging of servo valve, actuator and feedback device. This is fortunate because high temperature and high vibration requirements can only be met by such a compact package.

• **High Temperature Sources**—There are three general sources of heat which account for the high temperatures to which hydraulic systems are exposed in today's aircraft. These are: 1. aerodynamic heating as a result of supersonic flight speeds, 2. proximity to heat emitting sources such as engines and electrical equipment, and 3. power losses in the hydraulic system. Combination of the first two of these factors can produce ambient temperatures of 1000 F or more in high-performance aircraft and missiles. At such ambient temperatures, any power losses in the hydraulic system can easily cause the system to stabilize at 1200 F or higher.

• **Operating Temperature Limits**—Certain of the essential parts of a hydraulic system limit successful operation to temperatures no higher than 600 F. These are the organic materials in the system. For instance, the silicate

G. R. KELLER, Power Elements Group Leader, Autonetics Div., North American Aviation, Inc., Downey, Calif.

ester hydraulic fluids which are being proposed for qualification under specification MIL-H-8446 are designed for operation at 400 F. As temperature rises above 400 F, useful life of this fluid is sharply diminished. It does not appear that these fluids will have any significant life at temperatures of 600 F or more. This temperature also appears to be the limit for elastromeric parts and backup ring materials.

• **Solving the Problem**—If 400 to 700 F materials are to be used at 1000 to 1200 F ambient temperatures, some cooling method must be used. The obvious technique is to use a heat exchanger to cool the fluid. Cool fluid then circulates through the entire system to cool the components. However, this method fails to cool the control-surface actuators since fluid usually flows back and forth in the actuator but never actually leaves it. Also during cruise flight, control-surface servos may operate little if at all. Then no cooled oil would be supplied to the actuator. Such conditions would cause rapid failure of oil and other components in the actuator.

Need for cooling the actuator directly rather than cooling the fluid and the requirements of particular operations has led to the design of some new and unconventional actuators. One of these, Figure 1, has an external cooling jacket through which cooling fluid is circulated to maintain fluid in the actuator at 400 F or below in ambient temperatures of 700 F. This actuator has performed very satisfactorily at this temperature.

To assure proper coolant distribution throughout the jacket, baffles are formed in the body material by a chemical milling process. Proper location and shape of these baffles is determined by plotting the flow with an electrical field analog plotter. A typical analog flow plot, Figure 2, shows the cooling jacket as if it were cut along a line on the side opposite the ports and then unrolled to form a flat pattern. Since the jacket is symmetrical about the line of the cut, only the flow pattern

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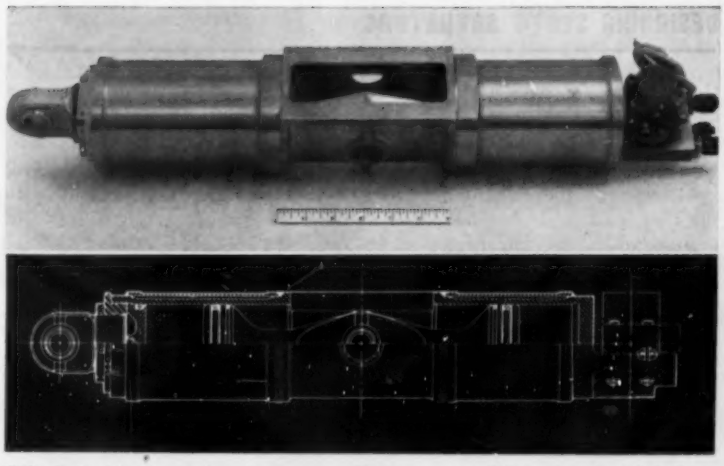

FIG. 2. Inside-out jacketed actuator eliminates possibilty of rod seal failure from abrasive particles formed when oil film on extended rod is exposed to high ambient temperatures. Two pistons are joined by a rigid link.

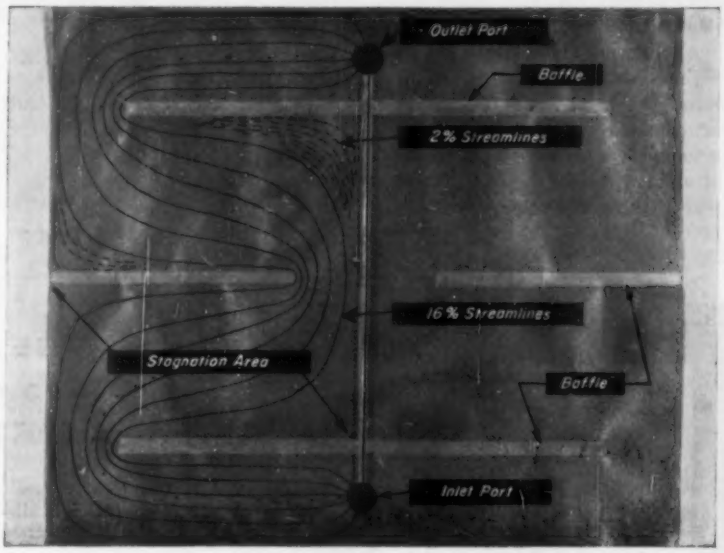

FIG. 3. A typical analog flow plot to test baffling of a jacketed actuator. Easily visible stagnation areas permit redesign to eliminate them and thus obtain uniform cooling.

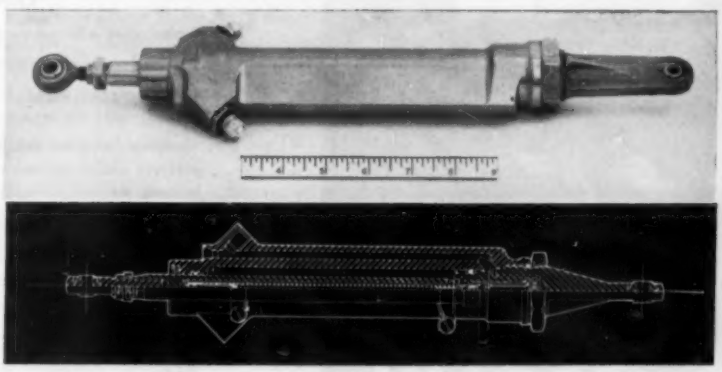

FIG. 4. Actuator which could not be jacketed has a poppet valve in the piston head which opens when the cylinder is retracted to permit sufficient flow for cooling through a small orifice in the head. Actuator performs satisfactorily after long exposure to 1000 F ambient temperature.

for one-half of the jacket was plotted.

Spacing of the streamlines in the flow pattern is an indication of flow velocity. Wide spacing indicates low flow velocity and close spacing shows high flow velocity. Stagnation areas where cooling flow would be inadequate are readily apparent because of the total lack of streamlines. Based on such a study, baffling was redesigned to eliminate stagnation areas. Use of the analog field plotter allowed quick evaluation of many baffle patterns without the expense of actually making the jackets.

Another problem connected with high-temperature cylinders and the solution are demonstrated by the actuator shown in Figure 3. This actuator has operated successfully at ambient temperatures to 900 F with maximum oil temperature of 500 F. At ambient temperature such as this, even though the cylinder body is jacketed and cooled, the thin film of oil adhering to the rod as it is extended will quickly volatilize and leave an abrasive residue. This residue quickly ruins the gland seals, causing leaks and failure.

This design solves the problem by eliminating the conventional rod. Here, what might be termed the rod, joins two pistons and there are no rod seals. This design has been called an inside-out cylinder because of its construction. Power pick-off point is between the two pistons. Oil films are left on the inner surfaces of the two cylinders of this actuator by the piston seals and these surfaces are not sealed from ambient air. However, the surfaces are kept cool by the coolant in the jackets.

In each of the two actuators discussed, the servo valve may be mounted directly on the actuator. If a translatory pickoff is used, it may be mounted inside the actuator rod. This type of assembly provides high resistance to thermal shock, high vibration and damage from rough handling.

• **Unjacketed Actuator**—On occasion design requirements for an actuator which will remain stationary for extended periods at high temperatures do not permit jacketing. A design to fit this requirement is shown in Figure 4. During the long nonactuated period, the cylinder is held closed by hydraulic pressure. Closing the actuator automatically unseats an integral poppet valve in series with a filter and an orifice. This permits enough flow for cooling through the piston head while maintaining pressure in the system. The filter prevents clogging of the orifice. When pressure is reversed, the poppet seats and the cylinder functions normally. Servo actuators of this type have performed successfully after exposure to 1000 F ambient temperatures for many hours. ▼▼▼

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

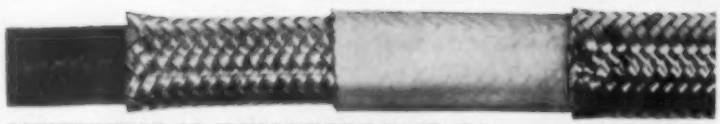
Need for a high-temperature, high-pressure, aircraft-type hydraulic hose has been one of the stumbling blocks in the path of the aircraft hydraulic system designer for several years. As little as three years ago, the absence of such a product threatened to seriously hamper many high-temperature hydraulic developments.

AIRCRAFT HOSE DEVELOPMENT

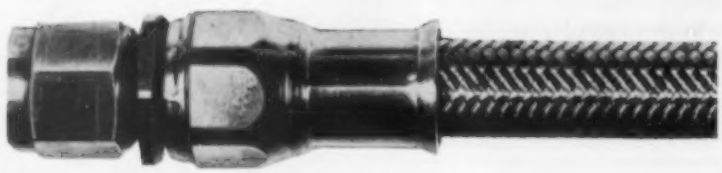
. . . for high pressures and temperatures

• By Irving D. Press

Vice President-Engineering, Resistoflex Corp., Roseland, N. J.



CONSTRUCTION OF FLUOROFLEX-T HOSE. Teflon compound tube is covered with primary reinforcing inner braid of cadmium-plated, carbon-steel wire. Teflon interlayer on top of primary braid is covered with stainless-steel outer braid.



DESIGN OF FITTINGS for use with Fluoroflex-T hose differs radically from conventional fitting design. Since the Teflon tube is slippery, nonresilient and nonswelling, fittings must apply constant, balanced forces to grip the tube regardless of any tendency of the material to deform.

GREATEST problem in developing hose for high temperatures and pressures was to find a suitable material for the fluid-carrying flexible tube that would resist high-temperature corrosion, degradation and creep. The fluid attack problem was extremely severe because of the greater chemical activity of many of the commonly-used aircraft fluids at elevated temperatures. This was compounded by the fact that some of the newer fluids slated for even higher temperatures were still in the evolutionary stages; and that entirely new ones, not yet conceived, could be anticipated in the future.

• **Fitting Requirements**—Fittings, also had to be perfected which would function dependably with the high temperature hose. They would have to provide a leaktight seal and have positive holding power over a very wide range of temperatures and pressures and any and all combinations of these conditions.

• **Hose Development**—Only raw material available, or anticipated, which seemed to possess the basic properties for this need was Teflon. Although Teflon, a Du Pont produced material, has all of the necessary favorable attributes, certain other characteristics can only be regarded as limitations. Products previously made of Teflon had demonstrated a considerable amount of cold flow, a high coefficient of thermal expansion and, unless fabricated under the most carefully controlled conditions, a tendency toward porosity.

While variations in properties of plastics generally are achieved primarily by the addition of plasticisers and other compounding ingredients, it was known that, with Teflon, major variations in properties also resulted from the fabricating techniques themselves. For example, flex life

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TABLE I—PERFORMANCE RATINGS FOR FLUOROFLEX—TR700

Fluid Temperature range-	-65F to +400F (To higher temperatures for short periods.)
Ambient Temperature range-	-65 F to +400 F (To higher temperatures for short periods.)
Working pressure-	3000 psi.
Surge pressure-	4500 psi.
Burst pressures-	Same as MIL-H-5512 (MIL-H-8788).
Bend radii-	Same as MIL-H-5512 (MIL-H-8788).
Fluid to be conveyed-	All fluids.
Shelf life-	Unlimited for all practical purposes.
Operating life-	Unlimited for all practical purposes. (With respect to temperature, fluid and natural aging effects; fatigue life of wire reinforcement provides the only limiting actor.)

TABLE II
FLUOROFLEX-T AND MIL-H-5512 SIZE AND WEIGHT

Dash Size	Outside Diameter in. MIL-H-5512	Fluoroflex-T R700
—4	5/8	15/32
—6	49/64	35/64
—8	55/64	11/16
—12	1-7/32	1.000

Dash Size	Weight (lb) MIL-H-5512	Fluoroflex-T R700
—4	.30	.19
—6	.40	.22
—8	.47	.31
—12	.73	.64

TABLE III
COMPARISON OF MIL AND FLUOROFLEX-T FITTING SIZE

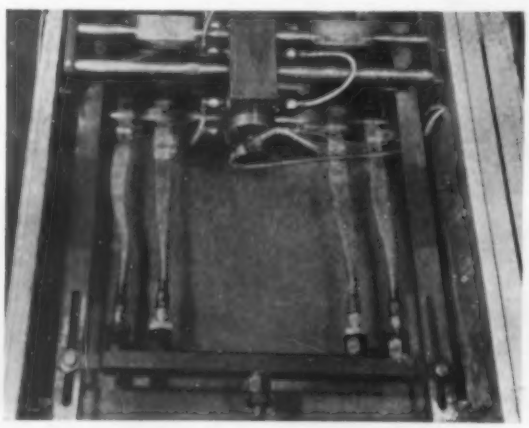
Dash Size	Fitting Hex Size MIL-H-5512	Fluoroflex-T R700
—4	3/4	11/16
—6	7/8	13/16
—8	15/16	15/16
—12	1-5/8	1-1/4

Dash Size	Fitting Lengths MIL-H-5512	Fluoroflex-T R700
—4	2	1-13/16
—6	2-23/64	2- 1/32
—8	2-13/32	2-11/64
—12	2-49/64	2- 9/16

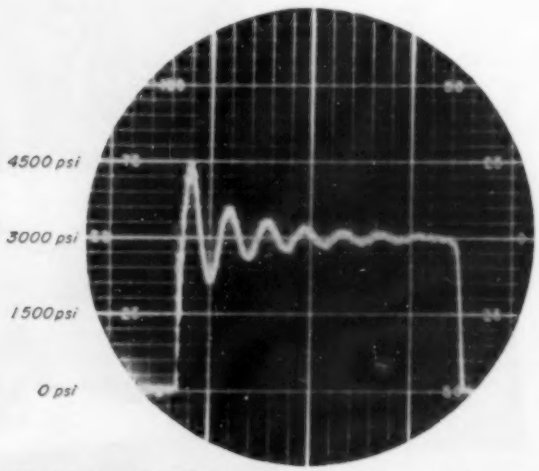
could be varied by a hundredfold, permeability to gases tenfold and stiffness fivefold. A satisfactory end product, therefore, would require considerable skill in design and choice of manufacturing equipment and techniques combined with close supervision and careful control.

Early in 1953, a Teflon compound which not only extruded satisfactorily but which also possessed the other essential requirements for proper hose construction was developed. It did not tend to porosity. Its extraordinary resistance to cold flow, its very high tensile and tear strength, its exceptional flex life, and a host of other desirable properties permitted the design of "the ideal hose." This hose, was designated Fluoroflex-T R500.

Fittings for conventional synthetic hose rely on resilience of the tube stock itself, and even on its tendency to swell when exposed to fluids. Fittings for this new hose, necessitated an entirely different approach. The tube stock not only was not resilient but was actually non-adhering and slippery. The solution lay in providing a gripping area in which opposing forces would be balanced and constant, regardless of any tendency, however slight, of the material to deform under the pressures applied.



FLEXING TEST IN PROGRESS. Two hose assemblies are correctly mounted and two are mounted with 15-deg. right-hand twist to simulate improper installation. Test conditions are: fluid temperature—450 F; ambient temperature—350 F; total amplitude—¾ in.; frequency—2000 cycles per minute.



OSCILLOSCOPE TRACE shows impulse test thermal sequence. Experience gained in testing indicates that temperature cycling tests are much more severe than those based solely on sustained exposure to high temperature.

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300 cubic inches | **650 cubic inches** | **900 cubic inches** | **1300 cubic inches**

In mid 1953, Fluoroflex-T R500 Hose and fittings, designated R3800 Hose Assemblies, were introduced. They were rated for 450 F continuous ambient and fluid temperature service and 1000-psi working pressure. These service ratings were based on long-term, exhaustive tests plus the results of evaluation programs conducted by cooperating user companies. It was known at the time that the temperature and pressure ratings were extremely conservative.

• **Further Development**—Even as this basic hose assembly was introduced, work was already under way to extend the program to encompass the 3000-psi working pressure required for high-temperature, high-pressure hydraulic usage. During the course of this program, many customers requested permission to use Fluoroflex-T R500 Hose at pressures exceeding 1000 psi. Where conditions were clearly defined such installations were authorized.

As a result of this field service and much additional laboratory testing at higher working pressures, it became obvious that upgrading was justified. The 1000 psi working pressure rating on hose sizes -4, -5, -6, -8 and -10 was therefore raised to 1500 psi for hydraulic service.

At the beginning of the 3000 psi program it was decided to utilize, as a guide, much of Specification MIL-H-5512 with respect to pressures and sizes. In addition, a survey was made among airframe and engine manufacturers to determine expected operating conditions and preferences. Out of the investigation came a design specification combining most of the size requirements and performance tests of MIL-H-5512—upgraded with respect to temperature—and including many of the special tests used in the Fluoroflex-T R500. Hose development, particularly those applicable to high temperatures. In general, the tests were designed with one eye on the effects of temperature cycling. Experience gained in the Fluoroflex-T R500 program indicated that tests under conditions of temperature cycling were more severe than those based solely on sustained exposure to elevated temperatures.

• **Impulse Testing**—Impulse test requirements of MIL-H-5512 with fluid and ambient temperatures raised to 400 F were used.

To provide temperature cycling, the impulse test was set up so that the required minimum number of impulse cycles would be achieved in no less than five complete cycles of temperature. In running the standard 100,000-cycle impulse test, a minimum of 80,000 cycles at full ambient and fluid temperature were specified to permit warmup and shutdown time for the heating equipment.

• **Service Experience**—All tests were satisfactorily concluded. However, because of the limitations inherent in the test equipment, instrumentation and procedures and because of the critical nature of the applications in which it was to be used, the resultant high-temperature, high pressure hose was introduced originally as a prototype designated by the letter *Y*. It was known, therefore, as Fluoroflex-T YR700 Hose and the hose assemblies were given the designation YR5800. Tens of thousands of these assemblies have now been in service under the widest range of temperature conditions for periods of up to two years. Many of them were put into operation as replacements for rubber hose in applications where actual service conditions exceeded those originally anticipated. In some cases, Fluoro-flex-T YR700 Hose was selected for its superiority at sub-zero temperature rather than for service at elevated temperatures.

As a result of this extensive service experience and availability of more accurate test equipment and instrumentation, it has been possible to remove the prototype designation and this outstanding hose is now known as Fluoroflex-T R700 Hose. In certain instances where the *Y* prefix has already been frozen into the design and specifications of production equipment and where the *Y* designation cannot conveniently be eliminated, it is being retained but it no longer carries the prototype connotation. Assemblies made of Fluoroflex-T R700 Hose coupled with flared fittings are designated as R25800 Hose Assemblies; when coupled with flareless fittings, they are designated R295800 Hose Assemblies. They are available in ¼, ⅜, ½, and ¾-in. sizes. A ⅝-in. size is being designed.

• **Advantages**—Aside from the high-temperature performance of Fluoroflex-T R700 Hose, a multitude of other benefits accrue from its use. Non-aging characteristics of the material and its freedom from corrosion, erosion, weathering, fungi and mildew result in practically unlimited shelf life and assure that properties designed into the hose originally will remain constant throughout its long life.

Complete chemical inertness makes it useful for all fluids—a basic advantage in high temperature hydraulic systems because of the continuing state of flux prevailing with respect to high-temperature fluids themselves. Absolutely clean lines with no possibility of the tube swelling, eroding or contaminating the fluid stream are assured.

Favorable strength-weight ratio of the tube makes possible an unusually light construction without sacrifice of ruggedness or durability. Size and weight comparison with MIL-H-5512 hose is shown in Table I. This size reduction permits use of smaller, more compact fittings. The size comparison with standard fittings currently made for MIL-H-5512 hose is shown in Table II.

• **Future developments**—Fluoroflex-T Hose is currently undergoing tests for Type IV hydraulic system service (high temperature limit 550 F). Indications to date are that it will be satisfactory, although it is too early in the test program to state specifically its operating characteristics under these conditions. The smaller sizes are being evaluated for service at 4000-psi working pressure. ▼▼▼

THE VITAL DIFFERENCE

Flight-proved high temperature FLUOROFLEX®-T hose assemblies

FLUOROFLEX®-T:
Aviation's most advanced hose

The Original fluorocarbon hose

Patented tube compound

Greater flex life

Superior impulse life

Leakproof, blowoff-proof fittings

Two years of flight experience now stand back of this high temperature 3000 psi hydraulic hose . . . the best proof of reliability.

This hose achievement reaffirms that the Fluoroflex-T patented tube does make a *vital* difference . . . affording corrosion-proof plumbing of highest integrity. The lines have solved the fatigue problems met in many high temperature high pressure applications. Their Resistoflex-designed fittings locked tight to hose give complete assurance against blowoff under severest conditions.

These assemblies are the first to pass the Wright Field high pressure, high temperature hose tests.

VITAL FACTS ABOUT FLUOROFLEX-T

All Fluoroflex-T hose starts with Teflon powder — which is only a *raw material.* It's a known fact that compounding ingredients and the fabricating techniques used with Teflon can vary properties in the end product *substantially.* Therefore, the fabricator's integrity and experience are the user's best assurance of performance and reliability.

Many years of research and testing went into the development of the unique and patented Fluoroflex-T tube. The 3000 psi hose assemblies emphasize anew the conservative policy of Resistoflex in presenting a product. *Long term* testing and *field service* were essential phases in the development. Send for data.

® *Fluoroflex is a Resistoflex trademark. Teflon is a DuPont trademark.*

Originators of high temperature fluorocarbon hose assemblies

Resistoflex

CORPORATION

Roseland, New Jersey • Western Plant: Burbank, Calif. • Southwestern Plant: Dallas, Tex.

AVIATION NEWS

from the fluid power field

Robert D. Cameron, Field Sales Engineer, has been assigned to the **Stratopower** Western Sales

Robert D. Cameron
Stratopower Div.
New York Air Brake Co.

Div., Los Angeles, by **Watertown Div., New York Air Brake Co.** Mr. Cameron was formerly assigned to the Eastern Sales Div. with headquarters at Watertown, N. Y.

Completion of arrangements by Weatherhead with **Autry, Rushin and Dane, Inc.,** Atlanta, Ga., to serve as manufacturers representative for its aviation products in six southeastern states is also announced. **Associated Aircraft Supply Co.,** Dallas, Tex., is southwestern distributor.

Martin R. Sidener, formerly with associated Air Services, Wichita, Kansas, has joined **New York Air Brake Co.** and will be assigned to the **Stratopower** sales office in Dallas as Field Sales Engineer.

Waldorf Instrument Co., Div. F. C. Huyck & Sons, announced the appointment of **Anthony Drabicki** to the position of Chief Application Engineer on fluid systems and components. Mr. Drabicki will be located at the main plant in Huntington Station, N. Y.

With its moving-assembly weighing only 16 lbs, the Hydrashaker developed by **Wyle Mfg. Corp.,** El Segundo, Calif., has a force capacity effectively many times greater than electrodynamic types weighing 275 lbs. At 45g acceleration, only 720 lbs force is absorbed by the moving-assembly, permitting test of 350-lb specimen at this acceleration level. Final stage of the hydraulic amplifier is driven by a small electromagnetic transducer. Metal-to-metal contact is eliminated as all moving parts in the amplifier are

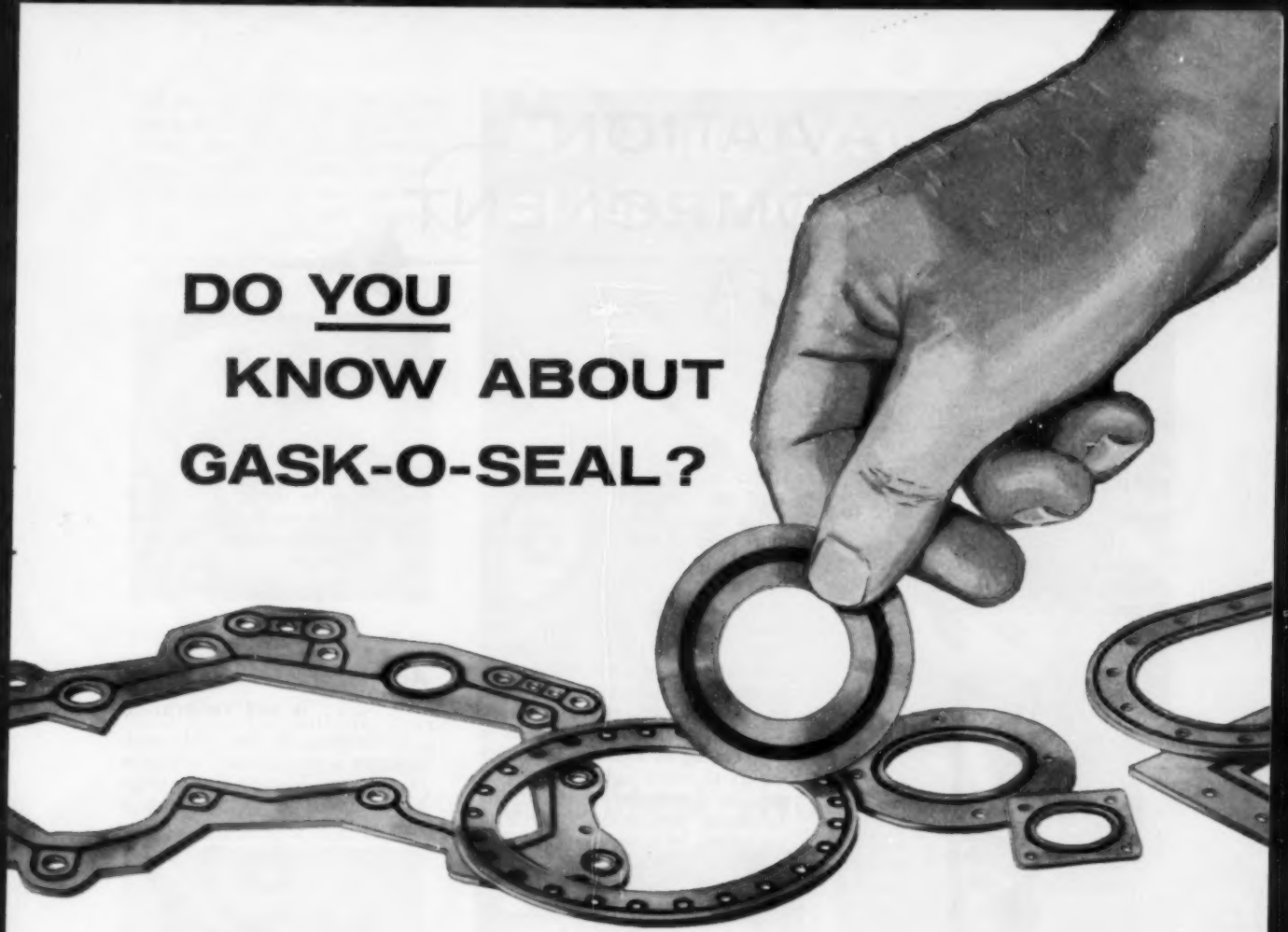
supported hydrostatically by hydraulic fluid. Overloading will not damage equipment because output piston can be stalled indefinitely without harmful effect.

To further avaition performance and safety, a new fire-test laboratory for testing aircraft hose assemblies and other components under in-flight fire conditions, has been opened by **Resistoflex Corp.,** Roseland, N. J. This hose fire-test unit duplicates equipment used by the CAA Technical Center in Indianapolis, and is capable of

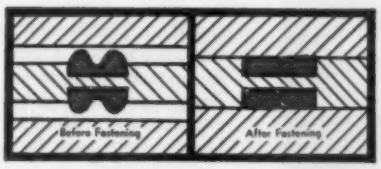
the same type and intensity fire testing as the government laboratory. Contradictory results in testing made it impossible to establish adequate fire safety standards for flexible plumbing. With these two identical test units, it will now be possible to confirm test results.

Watertown Div., New York Air Brake Co. announces the appointment of **Albert Ulmer** to Field Sales Engineer, Eastern Sales Div. Mr. Ulmer, formerly a field service engineer for the Stratopower sales office in Dallas, will make his headquarters at Watertown, N. Y.

DO YOU KNOW ABOUT GASK-O-SEAL?



The static seal that can not blow out!



The above diagram is "typical" only. Gask-O-Seals are also made with one-side seals.

If you do not know about Gask-O-Seals look at these facts:

- Gask-O-Seals will seal practically any processable fluid . . .
- Gask-O-Seals can be re-used . . .
- Gask-O-Seals will seal at low or high pressures, vacuum or positive . . .
- Gask-O-Seals are available as standards and as specials in almost any configuration or to meet special requirements.

They are recommended for flanges, gear boxes, transfer cases . . . any place where truly efficient static seals are needed.

Note: A recent development of the Gask-O-Seal principle indicates effective sealing in the temperature ranges of −400° to +1000° for specific applications.

®—the O-Seal family:
Lock-O-Seal®
Gask-O-Seal®
Stat-O-Seal®
Bolt-O-Seal®
Rin-O-Seal®
Banj-O-Seal®
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Culver City, California
"sealing design specialists"
A DIVISION OF Parker APPLIANCE COMPANY
Hydraulic and fluid system components

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AVIATION COMPONENT DATA

Air Relief Valve

. . . weighs 0.12 lb

MC 1613 relief valve is designed for operation with air or nitrogen at pressures to 3800 psi. Ambient temperature range is

−65 to 250 F. The valve conforms to applicable sections of MIL-P5518A and MIL-P-8564. Port connections are for ¼-in. tubing. Features of the valve are compactness, accurate setting and extremely low leakage.—*M. C. Mfg. Co., Lake Orion, Mich.*

Circle 300 on Reader Service Card

Silicone Rubber Compound

. . . has unusual strength

Designated SE-555, a new silicone rubber compound possesses unusually high strength for this type of material. Strong enough to replace organic rubber in many applications, the material is especially suited for aircraft seals and gaskets for —150 to 500 F operation. Typical physical properties include: tensile strength, 1600 psi; elongation, 650 −850%; tear strength, 220—250 lb/in. Requirements of AMS 3345 for tensile and tear strength, elongation, dry heat resistance, compression set and low temperature flexibility are readily met or surpassed. All conventional methods for fabrication and curing of silicone rubber may be used. The material may be molded in thick sections or extruded with wall thicknesses of 10 mils or less. Tinting to obtain an unlimited variety of colors including white is possible. Compounding with fillers to obtain hardnesses higher than the normal 50 durometer is possible. —*Silicone Products Dept., General Electric Co., Waterford, N. Y.*

Circle 301 on Reader Service Card

Flow Regulators

. . . offer constant flow

Designed to meet the trend in airborne equipment for higher speeds, greater power and precise control through all phases of op-

eration, this flow regulator maintains approximately constant flow rate regardless of upstream and downstream pressure. In normal operation, fluid passes through an orifice, into a piston and out to the component line through unrestricted ports. Metering of the fluid flow occurs when pressure drops across the piston orifice, moving the piston against the spring. This action varies the port size to maintain constant flow.—*Waterman Engineering Co., Chicago.*

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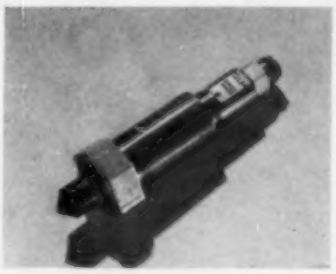
Accelerometer

. . . is self calibrating

Calibration of the SLM accelerometer is accomplished by a twist of the wrist. Turning the accelerometer upside down generates a



signal of 2 *g*. It will operate continuously at 500 F and is available in frequency ranges to 50,000 cps. Fast response, high accuracy and extreme ruggedness are features. Output signal can be preamplified and displayed on an oscilloscope or used with a recorder.—*Kistler Instrument Co., North, Tonawanda, N. Y.*

Circle 303 on Reader Service Card

Multi-Circuit Timers

. . . offer flexibility

A new line of Military Spec. time delay relays and sequence program switches offers up to six load circuits in the repeat-cycle timer

and up to five load circuits in the reset-cycle unit. ATC Mil. Spec. timers were developed for varied requirements of sequence programming, avoiding the need for custom-made units for each program. Timing cycles can range from split seconds to hours. On reset cycle timers, time delay may be changed

when required by turning an external adjustable delay mechanism. Motors operate on 115 v, 400 cycles. Load switches are single-pole, double-throw precision type. Units operate from —55 to 85 C up to 50,000 ft, have required four sizes of envelopes, are hermetically sealed, and weigh 16 to 24 oz.—*Automatic Timing & Controls, Inc., King of Prussia, Pa.*

Circle 304 on Reader Service Card

Fittings Wall Chart . . .

Handy 20 x 28-in. size, contains illustrations and part numbers on the complete MS ER flareless tube fitting lines, as well as the flareless cluster fittings. Step-by-step assembly instructions are also given. Offered to all interested engineers and designers by Weatherhead Co., Cleveland.

Circle 305 on Reader Service Card

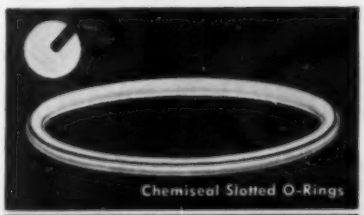
Miniature Pump Cartridge

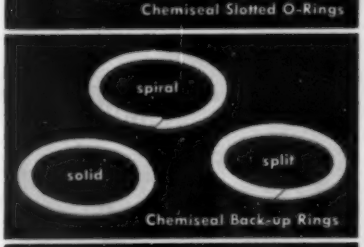
. . . smaller than watch

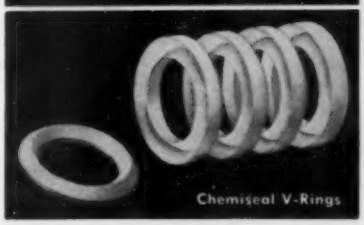
Less than 1⅛ in. in diameter and weighting 2.5 oz, a new vane pump cartridge will deliver 1.04 gpm at 1000 psi. The cartridge can be supplied singly for incorporation in the user's housing, in multiple units on a common shaft, or the manufacturer will supply single or multiple units in suitable housings. Suggested uses for the unit which can be manifolded effectively with

Continued on next page

Chemiseal® Hydraulic Packings







Because Chemiseal† Hydraulic Packings provide the reliability of TEFLON*, they are preferred by leading engineers for maximum security at vital points in aircraft hydraulic systems.

Chemically impervious, Chemiseal packings require no chemical inspection, have zero swelling in all hydro-carbons, new synthetic hydraulic fluids and solvents.

They offer unsurpassed anti-friction properties, are tough, resilient, non-flammable, long wearing. They have a service temperature range from minus 110°F to plus 500°F.

Have you tested the complete line of Chemiseal packings for aircraft hydraulics? Write for further information and samples.

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United States Gasket Company
Camden 1, New Jersey

United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

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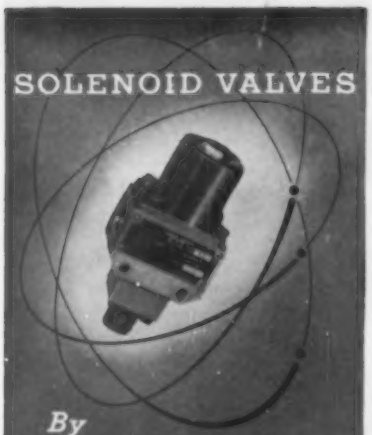
SOLENOID VALVES



By

M.C. MFG. CO.

The one shown is:
MC 2644-1 VALVE—SHUT OFF SOLENOID OPERATED
fulfilling the following aircraft specifications:
FLUID: Air or Nitrogen
PRESSURE RANGE: 0 to 1500 psi
TEMPERATURE RANGE: −65°F to +160°F
FLOW FACTOR: F=.05
INTERNAL LEAKAGE: 10 cc/min. max. at 18 to 30 volt DC, 200 to 1500 psi inlet pressure
EXTERNAL LEAKAGE: Zero
SOLENOID: Continuous duty
Voltage range 18 to 30 volt DC
1.5 amps max. at 27 volt DC
PORT CONNECTIONS: Per AND 10050-4
WEIGHT: .9 lbs.
MILITARY SPECIFICATION: Applicable paragraphs of MIL-P-5518 and MIL-P-8564

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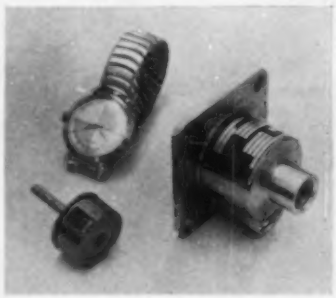
AVIATION COMPONENT DATA

servo valves, miniature hydraulic motors or fractional-hp electric motors are: small radar drives, small computer drives, electronic cooling, missile skin cooling, flow



dividers, etc. Similar to other vane-type pumps made by the manufacturer, the unit has automatic compensation for vane wear and is hydraulically balanced to eliminate pressure-induced bearing loads. Maximum recommended operating rpm is 10,000.—*Vickers, Inc., Detroit, Mich.*

Circle 306 on Reader Service Card

Service & Test Equipment

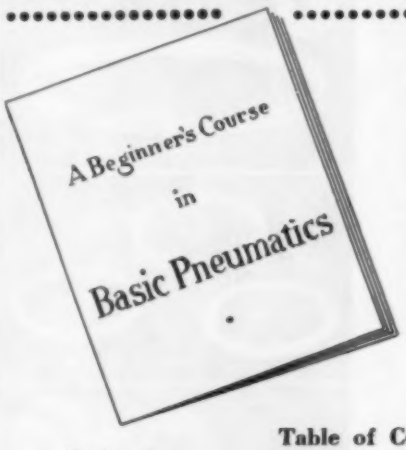
. . . is described in 16-page illustrated booklet. 55 different standard and custom test machines are covered, including hydraulic, pneumatic and electrical equipment for aircraft system and component testing, maintenance and ground supports. *Booklet No. 253, Sprague Engineering Corp., Gardena, Calif.*

Circle 307 on Reader Service Card

Diaphragm Seals

. . . have less friction

Diaphragm seals for aircraft, missiles and rockets, and industrial applications, fabricated from Nylon, Dacron, and Fiberglas, and coated with silicones and other common elastomers, are available precisely produced to customer's performance and design requirements. These



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seals allow transfer of fluid pressure energy to movement, are nearly friction-free, and seal effectively at —65 to 500 F, in a variety of fluids.

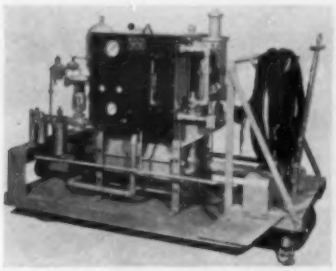
Fabricated with bores up to 12-in., with convolutions drawn to depths of 4-in., the diaphragms are available in thicknesses of .010-in., .013-in., and .018-in.—*Stillman Rubber Co., Culver City, Calif.*

Circle 308 on Reader Service Card

Test Stands

. . . use reciprocating pumps

Adaptable for both hydrostatic and functional testing, these test stands use reciprocating demand type pumps. Pressure is maintained under full flow or no flow while pump is almost motionless. When high rate of flow under pressure is needed, the unit delivers volumes



as required by demand. Air system for motor cylinder and its controls is entirely separate from the hydraulic system. Pump operates at 30 strokes per minute and action is almost vibration-free. The slow-moving feature, coupled with the separate hydraulic system, results in air-free hydraulic fluid and a minimum of heat.—*Ledeen Mfg. Co., El Monte, Calif.*

Circle 309 on Reader Service Card

Portable Power Pack . . .

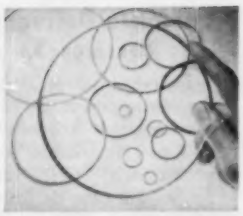
Operation of portable hydraulic power units providing fluid ground power to actuate and replenish hydraulic systems when aircraft engines are at a standstill, is described in a bulletin. Complete informa-

Continued on next page

Circle 141 on Reader Service Card

This trio's discordant tunes will likely land them in jail, ending their problem. If you prefer close-harmony in tight seals, United's Metallic O-Rings are the answer to problems involving metal-to-metal applications.

They fit any application calling for a positive, permanent seal against internal or vacuum pressures up to 10,000 p.s.i., in a temperature range from -70 to 1800°F. They are especially adaptable for sealing cylinder heads, air and hydraulic pressures, high octane fuels, vapors, gases, oils, solvents, chemicals, acids, vacuum and steam connections. Available in various metals and plating finishes, from 3/8" dia. to any size or configuration.



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Circle 153 on Reader Service Card

AVIATION COMPONENT DATA

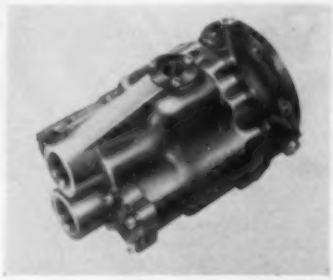
tion and specifications are given, including application photos, dimensional drawings, and flow vs pressure charts for 10 and 20 gpm pumps with constant hp input. Bulletin HP-200.—*Greer Hydraulics, Inc., Jamaica, N. Y.*

Circle 310 on Reader Service Card

Variable-Delivery Pump . . . has high hp per pound

Delivering over 50 hydraulic hp, the Stratopower 64W1000 pump has envelope size of 9⅛ in. long and 6¼ in. diam. Weight is approximately 19 lb, resulting in a hp/weight ratio of 2.8 hp/lb. Rated 10 gpm at 1500 rpm, the pump may be operated continuously at 4500 rpm to deliver 30 gpm. Maximum operating pressure is 3000 psi.

At operating speed, pressure differential between full flow and zero flow is less than 50 psi. Response is extremely rapid. Overall efficiency is 90% or more. Inlet pressurization required is 50 psi or less at full speed. Self-aligning rotating members and exceptionally low pulsation and oversurge char-



acteristics make this pump particularly well suited for aircraft use including servo applications. The pump is available in prototype quantities with resonable lead time and may be constructed in other sizes.—*STRATOPOWER Div., New York Air Brake Co., Watertown, N. Y.*

Circle 311 on Reader Service Card

Report on Helium . . .

Important as an inert charging gas in missile systems, is presented in 81 pages. This report, entitled "Physical and Thermodynamic Properties of Helium", and available in limited quantity, is a valuable addition to pneumatics engineering libraries. It corrects previous errors in Helium data, and covers many engineering areas previously not explored fully or accurately. *Wm R. Whittaker Co., Ltd., Los Angeles.*

Circle 312 on Reader Service Card

Teflon Hose Assemblies . . . with fixed or removable fittings

Designated Braid-lok, units have factory-attached or field-attached hose fittings. Braid-lok fittings employ a locking principle assuring blow-off protection. Fittings grip only on outer wire braid, locking it between two metal parts and trapping the Teflon inner liner independently to form a perfect seal. Super-Gem fittings can be attached or removed in the field using stand-

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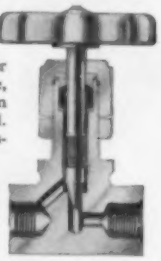
10,000 psi WORKING PRESSURE
FORGED BODY

One-piece, stainless steel, forged body and stem guide, with no brazing or welding—*can't* leak or come apart. Has many uses in water, gas, oil, and vacuum service.

Proofed at 25,000 psi for 10,000 psi working pressure, to 200° F. Semi-needle stem of *hardened* stainless steel. Available with graphited asbestos or Teflon packing.



Easy grip handle. Panel mounting. Female pipe connections, sizes ⅛" up to ½".

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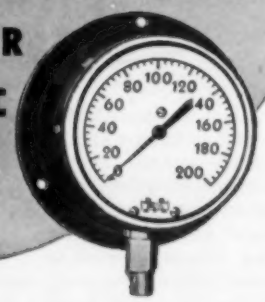

- PRESSURE
- VACUUM
- COMPOUND
- ALTITUDE
- COMBINATION
- DIAPHRAGM
- HYDRAULIC
- AND SPECIAL PURPOSE GAUGES
- DIAL THERMOMETERS

(Vapor Tension or Bi-Metal)

• Available in a wide variety of general purpose and special purpose gauges in pressure ranges to meet your specifications in every particular.

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ard bench tools. Available in straight, elbow, swivel and special shapes in several materials. Provide permanent sealing over full pressure

and temperature range of military specs. Teflon inner tube offers chemical inertness for operating range of −100 to 500 F.—*The Weatherford Co., Aviation Div., Cleveland.*

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Shut-Off Valves

. . . have ball seats

These valves are designed to provide reliable, bubble-tight flow control of air and oil through a pressure range of zero to 1000 psi, at −65 to 200 F. Features include spherical seats, straight-through flow, and d-c motor operation.

Valve body is aluminum with internal parts of hard-chromed, stainless steel, and seals of Mylar, Kel-F, or Teflon. Ports are per AND-10050. May be specified MS-33514 and AND-10056. Typical ⅜-in. model weighs only 1.25 lbs, including motor actuator and valve unit. Available in sizes from ¼-in. to 1-in.—*Hydromatics, Inc., Livingston, N. J.*

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By a leading aircraft designer . . .

AIRCRAFT HYDRAULIC DESIGN

by GEORGE R. KELLER
Group Leader,
Flight Control Engineering Dept.
Autonetics, A Division of
North American Aviation

George Keller is responsible for development, design, and testing of hydraulic systems and power servo-mechanisms for the flight control systems of missiles and inhabited aircraft.

He is particularly well known for his work in high temperature hydraulics and has written a number of papers on this subject. He is an active member of the aircraft committees of SAE and is a civilian consultant to the Office of Assistant Secretary of Defense.

Published by
APPLIED HYDRAULICS Magazine

• **The first book** dealing with hydraulic component and system design for high-speed piloted aircraft and missiles, has been written by a leading aircraft engineer. Developed from practical and theoretical material, the book develops many basic equations including those relating pressure gradient, flow-path dimensions, flow rate, velocity, fluid density, and viscosity.

• **Design of system components** including actuators, valves, pumps, accumulators, transmission lines and seals is discussed. Accumulator theory is presented with a detailed example of proper accumulator selection.

• **Hydraulic servo systems** are diagrammed and the transfer functions developed. Fundamentals of transient analysis technique and frequency response method of servo testing are given. The chapter on high temperature hydraulics outlines present progress in fluids, seals, springs, metals, and other critical components, and indicates future developments and techniques.

The advance of industrial hydraulics in servo components and systems makes this book of great value to designers of industrial equipment as well as aircraft engineers.

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APPLIED HYDRAULICS
ROUNDTABLE

ENGINEERS DISCUSS...

air and oil design at National Acme Company

- Last month AH editors met with top designers at National Acme to learn of their techniques, opinions, and ideas in using fluid power on their machines.

• What are the applications of hydraulics and pneumatics on National Acme equipment?

Actuating chucking jaws and positioning are two general applications. We are developing milling attachments driven by fluid motors. Stabilizing hydraulic and pneumatic cylinders are also used for back pressure against cams to take out the chatter. Feed and reverse clutches are actuated hydraulically. We take advantage of differential action to actuate clutches for two speeds. This is applied on our single spindle machines to a great extent. In loading we use both pneumatics and hydraulics, and we also have some hydraulic feeds.

• Are you considering higher operating pressures?

We do not have a trend toward high pressures. Size and weight are not sufficiently important to make reductions due to higher pressures attractive. Operation of National Acme equipment is usually at 500 psi. On special jobs it might be 800 psi. We could go to 1500 or 2000 psi with present components. In one case we ran at 16,000 psi with one of our own boosters. Metal cutting is in the low pressure range.

National Acme was represented by:
A. E. DRISSNER, Vice President & Chief Engineer
HAROLD MATLOCK, Assistant Chief Engineer
JAMES H. SMITH, Machinery Division
JAMES P. WARWICK, Supervisor, Machinery Quotations
ARTHUR CORDRAY, Project Engineer
WILLIAM MORGAN, Hydraulic Engineer
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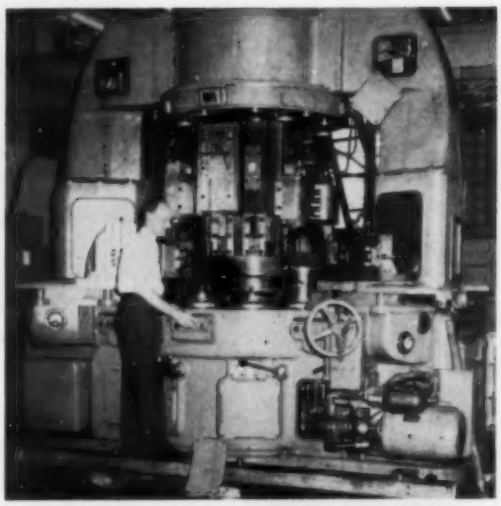

VERTICAL CHUCKER Acme-Ryder machine has hydraulic operation for chucks, clutches, spindle brakes, and other operations. Jack Higginson who has been supervising manufacture is shown with the partially assembled machine.

• Is synchronizing of cylinder motions required on your equipment?

If this refers to servomechanisms, yes. Otherwise, no. Synchronization is controlled electrically or mechanically. We only use hydraulics or servomechanisms—in tracers and positioning. Sequencing on our machines is controlled by cams.

Circle 7 ⟶

AFCO

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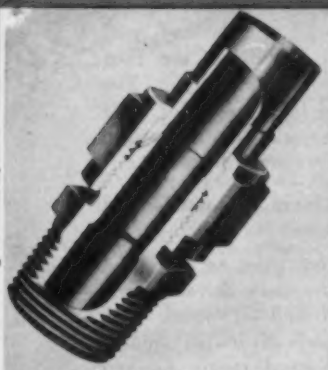
FITTINGS

STEEL • ALUMINUM ALLOY • BRASS • STAINLESS STEEL



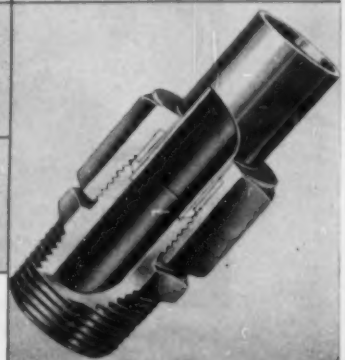
37° FLARED "J.I.C."

FLARED TUBE FITTINGS and PIPE FITTINGS

J 815 TUBE UNION	J 815-X-X REDUCER UNION						
J 816 MALE CONNECTOR	J 854 FEMALE CONNECTOR	J 821 TUBE ELBOW	J 822 MALE ELBOW	J 877 LONG MALE ELBOW	J 878 EXTRA LONG MALE ELBOW		
J 823 MALE ELBOW 45°	J 855 FEMALE ELBOW	J 824 TUBE TEE	J 825 MALE SIDE TEE	J 826 MALE RUN TEE	J 856 FEMALE SIDE TEE		
J 857 FEMALE RUN TEE	J 827 TUBE CROSS	J 832 BULKHEAD UNION	J 833 BULKHEAD ELBOW	J 834 BULKHEAD TEE	J 837 45° BULKHEAD ELBOW	J 806 TUBE PLUG – FLARED	J 860 TUBE END REDUCER
J 818 TUBE NUT	J 819 TUBE SLEEVE	J 820 TUBE CAP – FLARED	J 924 BULKHEAD LOCKNUT	910 PIPE CONNECTOR	911 PIPE NIPPLE	912 REDUCING BUSHING	913 SQUARE HEAD PLUG
914 90° STREET ELBOW	915 45° STREET ELBOW	916 PIPE ELBOW	917 PIPE TEE	918 PIPE CROSS	932 HOLLOW HEX PLUG	933 HEX HEAD PLUG	840 HOSE NIPPLE

FLARELESS TUBE FITTINGS

				F 815 TUBE UNION	F 815-X-X TUBE UNION REDUCER	842 90° HOSE ELBOW	844 45° HOSE ELBOW
F 816 MALE CONNECTOR	F 854 FEMALE CONNECTOR	F 821 TUBE UNION ELBOW	F 822 90° MALE ELBOW	F 823 45° MALE ELBOW	F 855 FEMALE ELBOW	F 824 TUBE TEE	F 825 MALE SIDE TEE
F 826 MALE RUN TEE	F 856 FEMALE SIDE TEE	F 857 FEMALE RUN TEE	F 827 TUBE CROSS	F 832 BULKHEAD UNION	F 833 90° BULKHEAD ELBOW		
F 834 BULKHEAD TEE	F 837 45° BULKHEAD ELBOW	F 860 TUBE END REDUCER	F 818 TUBE NUT	F 819 TUBE SLEEVE	F 924 BULKHEAD LOCKNUT		
F 929 TUBE CAP	F 806 TUBE PLUG						



FLARELESS

AFCO FITTING CO.

5300 Harvard Avenue Cleveland 5, Ohio

SEND FOR CATALOG ON THE COMPLETE LINE OF – AFCO INDUSTRIAL FITTINGS

• What steps have you taken to control leakage?

In the master distributor on our machines we had to put up with leaks until the advent of the O-ring. This seals an intermittent rotary motion and has cut our leakage to a minimum. The quad ring has also been effective on this application although installation is more difficult. We have also designed and built our own manifolds. These are welded construction type. We are using standard JIC, 37° flared fittings, and don't seem to have too much trouble with leakage. Since we have machines to do our flaring, we get a very uniform flare and our personnel are trained to do it more rapidly than installing other types.

• Your problem with flareless fittings is then chiefly an assembly problem?

Yes, and also we find that flareless fittings do loosen up on our applications over ¾-inch size.

• What types of manifolds do you make?

We take a blank and mill passages in it. Plates are then welded on top and bottom. The manifold is then tested for leakage. Occasionally pin holes are found, and we weld them shut.

• Where have you used fluid motors?

Here in our plant we have used fluid motor spindle drives on machines that mill our cams. This is a hydraulically-driven spindle with three speed ranges through gearing.

• Is the use of fluid motors on milling attachments new?

Yes, it is. One machine has two hydraulically positioned spindles on it. There is also a hydraulic spindle milling attachment on that. On a small machine it is difficult to find the space to fit an electric motor, so we are using a fluid motor drive.

• Does it cost much more to use the hydraulic motor?

It probably does, but there isn't too much variation between the electric and hydraulic when everything is taken into consideration. We do it to get more speed flexibility. We would like to find a smaller, more powerful, piston-type motor at a reasonable cost for this application.

• Could you get the power increase you need by increasing operating pressure?

No, because we use gear motors. Unless you use a piston type motor, you will have a slippage problem. Gear motors are very efficient up to 800 psi, but over that slippage becomes a big factor.

• What are your ideas on cylinder packings?

We prefer either the O-ring or V-ring type. O-rings on the piston

GOSHEN
GORBOND*
*Trade name for Goshen's exclusive bonding process.
sets a new standard of excellence in
RUBBER-TO-METAL ADHESION
developed and offered exclusively by
Goshen Rubber

If your problem is finding really dependable adhesion of a rubber compound to metal, then Goshen's exclusive bonding process, GORBOND, is for you. Parts made of natural, synthetic and silicone rubber compounds are being regularly bonded securely to metals of most every type . . . in a manner to meet the most exacting tolerances as well as material and performance demands. This superior process allows engineers wider freedom to employ the simplified design and lowered end costs possible through rubber-to-metal bonding of unexcelled reliability.

Write for Technical Bulletin No. 9

See our catalog in Sweet's Product Design File.

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IN SMALL PACKAGES

that SAVES you
SPACE and WEIGHT!

MAC-38D
Double Ram, Double Acting Air Cylinder

MAC-385
Single Ram, Double Acting Air Cylinder

MAC-385
Spring Return, Single Acting Air Cylinder

MAN-12
12-Port Manifold

MAV-2 & 3
2 and 3-Way Air Valves

Tiny but TOUGH are these miniature pneumatic cylinders, valves and accessories, engineered for automatic work and control applications where weight and space saving is mandatory.

All are precision made for millions of cycles of trouble-free operation by the pioneer manufacturer of miniature pneumatic devices. Be sure to consider them, NOW, to speed production or improve work quality AUTOMATICALLY, or for improving the new products you are designing.

Clippard miniature pneumatic devices are sold by the nation's leading distributors of Fluid Power components. Write for interesting new catalog, NOW!

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does a smooth job of
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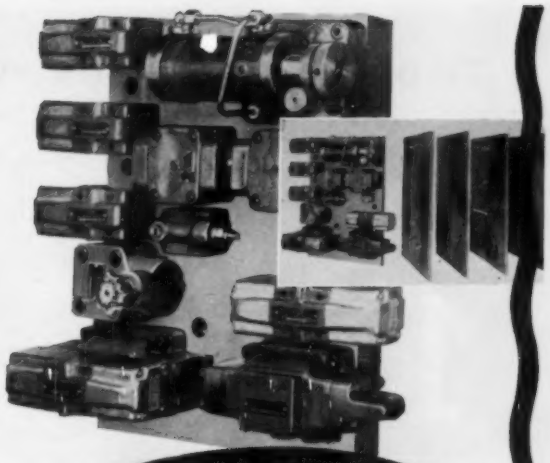

ALMO
HYDRAULIC CONTROL MANIFOLDS

CONTROL SYSTEMS READY FOR OPERATION—NO CIRCUITS TO PONDER OVER AT INSTALLATION

Leading machine manufacturers use these manifolds to cut costs and obtain permanent trouble-free operation. Send your hydraulic circuit print and sketch showing desired take-off connections. We'll prepare a manifold proposal—No obligation.

ALMO TOOL COMPANY
11470 Kaltz—Centerline, Mich.

"Design Wise"

Colonial Broach Co. uses an Almo manifold in this 15 ton capacity, 66" stroke dual-ram broaching machine.

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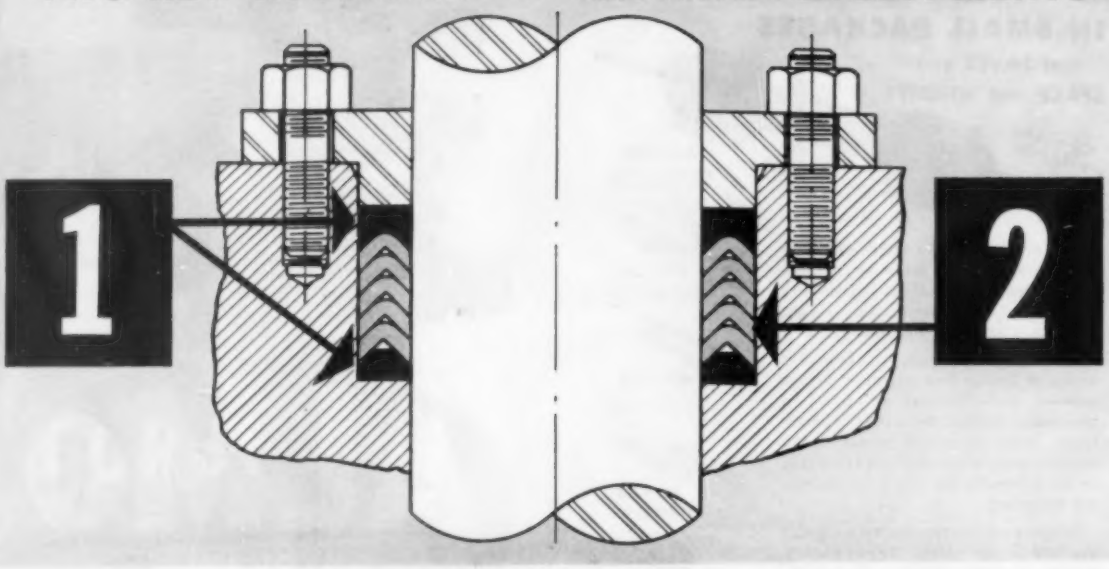
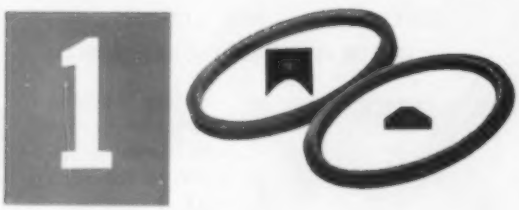
TWO NEW HOUGHTON "V" PACKING DEVELOPMENTS



SAVE TWO GLAND DESIGN JOBS



Houghton's new molded "V" Packing adapters do away with individually designed metal support rings. And besides saving you design work, they help "V" Packings make a better seal.

These molded rings can "give" under pressure, expanding to bridge the clearance. They'll flex without cracking. They're not subject to the fatigue that can break down metal rings. Because they expand along with packings Houghton Molded "V" Packing adapters provide better support and permit packings to give longer service.

Standard stack heights of Houghton "V" Packings give designers a break, too. When you use Houghton "V's" you don't need to design glands differently because packings of different materials will be used in them. Just figure the number of packings pressure requirements demand . . . then allow for the dimension in your design. Whether you use rubber, fabricated rubber, or leather "V's" . . . they'll fit. They are all the same stack height.

There's more than 50 years of hydraulic know-how behind these new design developments. They're typical of Houghton's complete line of hydraulic and pneumatic packings and hydraulic oils and fluids. For the full story, call your Houghton Man today—or write E. F. Houghton & Co., 303 West Lehigh Avenue, Philadelphia 33, Pa.

"V" PACKINGS

. . . products of

E F HOUGHTON & CO.

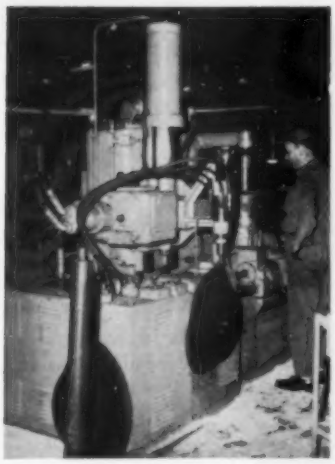
PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

and rod. In certain cases, we use V-rings on both the rod and the piston where space permits. In air applications we prefer to use the V-ring because of lubrication problems, and because O-rings tend to "spiral failure" in these applications.

• Does National Acme make its own cylinders?

Because of space limitations we make some. Some commercial cylinders take up too much room. However, wherever we can use a standard cylinder we do so.



CAM TRACING AND CUTTING MACHINE uses hydraulic tracing head to copy master cam. Cams are used to sequence screw machines.

• What is your experience with welded tubing?

We have tested some welded tubing and found it satisfactory, but we are not using it on our machines.

• Has adherence to JIC presented any difficulty?

We disagree with JIC on tubing recommendations. Use of copper should not be arbitrarily excluded. Instead of steel we use copper in the distributing end of our machines, because steel is too rigid for this application. Following JIC diagram requirements to the letter can lead to unnecessary drafting time. For example, the requirement for a sequence of operations on both the hydraulic and electrical diagrams.

SECO
ISO-FLO
PUMP

Advantages

- Several *isolated* flow outputs from one pump.
- Separate pressure control of these several outputs is accomplished without complex flow control or reducing valves.
- High flow, low pressure . . . and low flow, high pressure from one pump.
- Ideal for accumulator circuits . . . Does not require delicate and unpredictable automatic unloader valve . . . Eliminates constant cycling.
- Automatic unloading characteristics permit large savings in horsepower, and greatly prolonged bearing life.
- ISO-FLO pumps will accomplish most cut-back or clamping operations better than a variable displacement pump—and at lower cost.
- Ideal for parallel feed of cylinders.
- Output of one piston may be used to control the function or cycling of remaining pistons.
- Great flexibility of flow rates is obtainable simply by adding or removing pistons.

Available in models with 7 or 14 pistons. Capacities ½ to 10 G.P.M. Operating pressures over the entire 0 to 10,000 PSI Range.

SECO

SIMPLEX ENGINEERING CO.

Subsidiary of RACINE HYDRAULICS & MACHINERY, INC.

ZANESVILLE, OHIO

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- ♦ **SMALL SIZE plus HIGH FLOW RATES...** 12" unit shown here handles over 50 gpm
- ♦ **LOW PRESSURE DROP...** less than 3 psi

All-metal construction, carbon or stainless steel.
Two-stage filtration. Lowest cost-per-gallon.

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Filtration Engineers in Principal Cities

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ENGINEERS DISCUSS . . .

• How about the JIC requirement for reservoir location outside the machine frame?

We still like the tank in the machine. JIC has done a pretty good job, but in some instances we consider it increases the customer's maintenance job. One big JIC mistake was rigid electrical conduit to the valve. With the valve mounted on the manifold as we have it, with pigtail leads to the solenoids, all the customer has to do is take the plug out. With rigid conduit you cannot do this. We have found JIC electrical standards are much more rigid than the hydraulic standards.

• How do you educate the user in maintenance of your machines?

This is left up to the user. Companies in the automotive industries have their own schools. Many customers send men into our plant to learn about equipment to be delivered. On complicated tooling jobs, we have the customer send in men, or we send demonstrators along with the machine to break in the operators. We also send along diagrams and a handbook.

• Are you making use of static electrical controls?

No. We tried these but found them too expensive. Perhaps in the future we may get into it; we are not presently doing any development work on this.

• What is your practice on filtering?

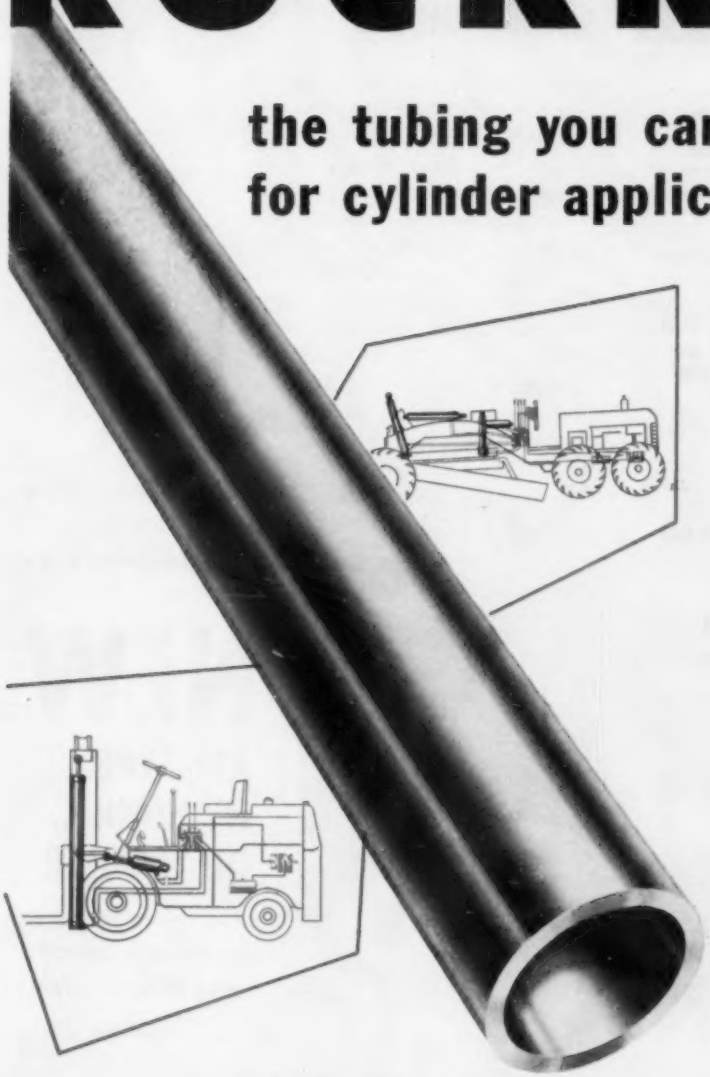
We stick to the screen or disc type, 150-mesh filter. We do not recommend other types, such as fuller's earth, because they take the additives out of the oil.

• How do you design to control temperature?

We haven't had any special temperature problems. When we first started using hydraulic circuits there was a lot of trouble with line sizes and reservoir capacity. If you have the proper line size, proper horsepower, a pump designed for the system, and sufficient reservoir capacity, you won't have any trouble. Most

REMEMBER ROCKRITE®-

the tubing you can use *"as supplied"* for cylinder applications



inside diameter needs no further processing –

inside working parts may be standardized –

When the design calls for cylinders, count on big savings with ROCKRITE tubing. Sized cold, by *compression*, ROCKRITE provides a polished-smooth, scratch-free surface and extremely close dimensional tolerances. No boring or honing is required. Parts production can be standardized from ROCKRITE tubing cut-to-length and used "as furnished."

For your next application that requires close tolerance I.D. tubing, *remember to reduce cost* with ROCKRITE.

***NEW TECHNICAL BULLETIN*—Write for it today!**

Describes how the ROCKRITE process imparts cylinder-finish to tubing. Application facts and performance data for your reference. Write for your copy of this Bulletin R7A, today.

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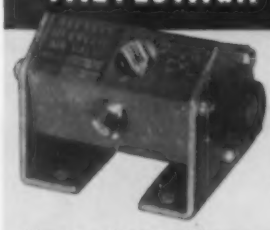
TUBE REDUCING CORPORATION

WALLINGTON, NEW JERSEY

Absolute control!

BECKETT

VALVES...air or hydraulic



Model B Beckett Hi-Cyclic Air Valve. Also made in two springloaded styles —Model BB ball point for cam operating, Model BSL for straight line actuation. Spool end nuts, or optional exhaust type speed controls may be used for velocity adjustment.

Now available with any of 7 spool types, Beckett "Basic Series" Valves with adjustable stroke spool provide positive piston control at high cyclic rates for an unlimited range of uses in many fields. Extremely small size makes them ideal for use in machine tools and other mechanisms—inexpensive, too!

Built in 3-way and 4-way types for use with—

AIR or NON-CORROSIVE GASES: NPT Sizes 1/8, 1/4, 3/8 and 1/2 Mod.; 5-port Dual Exhaust; 150 PSI pressure, or vacuum service.

HYDRAULIC: NPT Sizes 1/8, 1/4 and 3/8; 4-port Single Exhaust; 1500 PSI pressure.

. . . For any directional Control Valve Requirement

first check it with Beckett!

- A complete line of advanced-design air and hydraulic control valves. More than 150 models—solenoid, manifold, piloted, solenoid piloted, lever, cam roller, spring center, detent and combinations of these actuators.
- All spool types: 2 position, 3 position, float piston, open center, closed center, servo, port exhausting center position.
- All carried in stock for immediate delivery. Write for complete valve catalog or detailed information on Hi-Cyclic Valves to meet your specific requirements.

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THE BECKETT-HARCUM COMPANY

1086 WAYNE ROAD, WILMINGTON, OHIO

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SAFETY VALVE TEST STAND WITH "BUILT-IN" RELIABILITY

Reliability of the Safety Valve Test Stand is guaranteed by the well known repeatability and accuracy of I.E.C. Gage Gards. They prevent the pressure being measured by each pressure gauge from exceeding its maximum.

Completely reliable testing of safety valves is assured with the I. E. C. Test Stand. Four gauges give accurate readings, in the model illustrated, for pressures ranging between zero and 1000 pounds. Models are available for any ranges selected by the customer up to 10,000 pounds pressure. Adapter plates can be furnished to fit all sizes and types of safety valves. For complete information, please write for Bulletin 545.

INDUSTRIAL ENGINEERING CORPORATION

525 E. Woodbine, Louisville 8, Ky.

NEW

AIR-TYPE HYDRAULIC OIL COOLER

Reduces component costs and eliminates need of water piping

Make even your hard-working circuits work harder by removing excessive heat with a Rosaen oil-air cooler. There's no need for water in this air-cooled system, so you eliminate both the installation cost, and the waste, of water. The oil-air cooler takes no floor space, mounts directly over the power unit, as shown. In planning new circuits, those expensive components dictated by the need to keep the oil cool may be left out, and this cooler included at less over-all cost to efficiently cool the oil.

Both 12 gpm and 25 gpm models are available, are guaranteed for use with 30 psi fluid at 250° F. Also new is the Rosaen air-cooled reservoir, a cooler and reservoir combination that serves as a base for small power units. Write for complete catalog information.

The ROSAEN COMPANY

1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

of our reservoirs are four times the necessary capacity, and line velocity is kept down to about 10 fps. Therefore we have not needed oil coolers.

• What are your stocking and delivery problems on fluid power components?

Most of our machines use a power unit with the same type of motors, valves, etc. Stocking has not been a problem. Delivery today is not too bad.

CONSTRUCTION OF AUTOMATIC screw machine showing installation of air and electrical components.

• Have any hydraulic components been difficult to service or replace in the field?

We used to have piping nightmares, and there was quite a problem at that time. Now we have gone to panelling, manifolds, etc. Maintenance costs have been cut down. Service and replacement in the present machines is no problem.

• What applications do you have for accumulators? What type do you prefer?

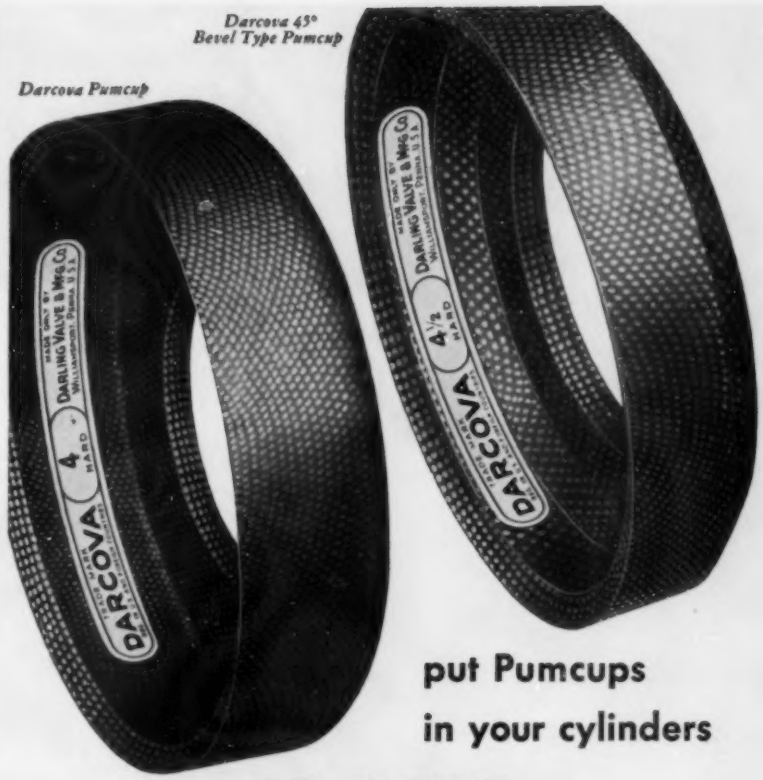
Accumulators on our circuits are mostly used to maintain chucking pressure during valve reversal. We normally stick with bladder-type accumulators, and we have only about .1% bladder replacement.

• Have you investigated piston-type accumulators?

Yes, but there you get into a length problem. They are rather bulky for our application. We had some bad experience when piston type accumulators leaked, but this has been corrected in newer models. ▼▼▼

Darcova 45° Bevel Type Pumcup

Darcova Pumcup



put Pumcups in your cylinders

TO HOLD PRESSURE LONGER!

In Darcova Pumcups a sound engineering principle has been combined with precision tolerances and extremely durable compositions to provide exceptional efficiency and life in hydraulic, air, and reciprocating pump cylinders of all kinds.

Unlike ordinary piston packing, precision Pumcups are engineered to minimize friction load while hugging cylinder walls on every pressure stroke. Regardless of eventual wear, efficiency *stays* high! So there's far less down-time and need for replacement.

Pumcups are made in a wide range of sizes, types and texture-engineered compositions, including 100% Nylon, for all kinds of pressure-temperature-fluid conditions. Send for Pumcup Bulletin 5503 and weigh all the facts!

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

Circle 39 on Reader Service Card

Masterpiece of simplicity

Consider the egg. Unique in shape, clean of line, its design is functionally perfect.

Much the same can be said of a MAC valve. Trim and compact, its simplified design meets the severe demands of our toughest customer. We engineered it to deliver the speed and stamina required by resistance-welding equipment . . . and knew this basic design would pay off handsomely in performance on less exacting jobs, too. That's why *all* MAC valves are built to these same rugged design specifications.

And that's why you can expect *more* from MAC—in efficiency and dependability, in longer life. Get proof. Contact a representative listed at right or send for the facts.

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park, Detroit 37, Michigan

MAC

PHONE YOUR NEARBY "MAC" REPRESENTATIVE FOR DATA AND DELIVERY

ARKANSAS
Branch-Merwin Tool Specialists, 447 N. Bellevue, Memphis, Tenn., BRoadway 8-6102

CALIFORNIA
OAKLAND 8—The Rucker Co., 4700 San Pablo Ave., OLympic 3-5221
SOUTH GATE—The Rucker Co., 4956 Firestone Blvd., LOrain 4-2521

FLORIDA
MIAMI SPRINGS—Aero Hardware & Supply Co., 4301 Northwest 36th St., TUxedo 8-2414

ILLINOIS
CHICAGO 43—Mike C. Modrich Co., 10918 South Western Ave., Hilltop 5-3640

INDIANA
EVANSVILLE—Neff Engineering Co., 2509 Washington Ave., GReenleaf 7-4141
FORT WAYNE 5—Neff Engineering Co., P.O. Box 2001, Station A, 2339 Crescent Ave., EAstbrook 7391
INDIANAPOLIS 20—Neff Engineering Co., P.O. Box 7361, 42nd St. Station, CLifford 5-5418
SOUTH BEND—Neff Engineering Co., 707 South Eddy, ATlantic 7-5655

MASSACHUSETTS (and New England)
BOSTON 34—Electrical Apparatus Co., Inc., 1200 Soldiers Field Rd., STadium 2-7440

MICHIGAN
BAY CITY—Fred Kober, 506 Chilson St., TWinbrook 2-2629
FLINT 2—Kober Sales Engineering Co., 1115 Root St., CEdar 2-7165
WESTERN MICHIGAN—Everett Adams, 17212 Sharon Road, Chesaning, Michigan, Victor 5-3446

MINNESOTA
MINNEAPOLIS 8—Air and Hydraulic Equipment Co., 15 E. 38th St., TAylor 3-6118

MISSISSIPPI
Branch-Merwin Tool Specialists, 447 N. Bellevue, Memphis, Tenn., BRoadway 8-6102

MISSOURI
ST. LOUIS COUNTY—Oscar E. Jost Co., P. O. Box 6, St. Ann, HArrison 8-4488

NEW YORK
BUFFALO 26—C. H. Tepas Co., 200 Washington Hwy., CIrcle 3210

OHIO
CINCINNATI—The R. W. Nichols Co., Fidelity Federal Savings Bldg., 2087-9 Sherman Ave., Norwood, ELmhurst 1-2440
DAYTON—The R. W. Nichols Co., 407 Realty Bldg., Michigan 4724
OLMSTED FALLS—The R. W. Nichols Co., P. O. Box 6, ADams 5-3366
TOLEDO 4—The R. W. Nichols Co., 510 Manhattan Building, CHerry 1-1447

OREGON
PORTLAND—The Rucker Co., 911 N. W. Hoyt St., CApitol 3-0205

PENNSYLVANIA
PITTSBURGH 22—The R. W. Nichols Co., 101 Investment Bldg., ATlantic 1-6050
PHILADELPHIA 41—Automation Aides, 4817 Old York Rd., Michigan 4-0807

TENNESSEE
MEMPHIS—Branch-Merwin Tool Specialists, 447 N. Bellevue, BRoadway 8-6102

TEXAS
DALLAS 35—Womack Machine Supply Co., 2010 Shea Rd., FLeetwood 7-3871

WASHINGTON
SEATTLE—The Rucker Co., 1000 4th Ave., South, MAin 2783

WISCONSIN
MILWAUKEE 17—Neff Engineering Co., 5856 N. Pt. Washington Rd., EDgewood 2-1579

CANADA
MONTREAL—L. S. Tarshis & Sons, Ltd., 450 McGill St., Quebec, PLateau 2963
TORONTO—Trevor Babbs, National Time & Signal Co., Agincourt, Ontario, OXford 1-4857

MECHANICAL AIR CONTROLS, INC.
DETROIT 37, MICHIGAN
MAC

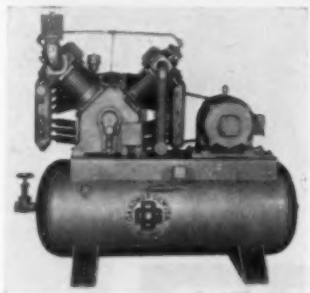
New Products continued

COMPRESSOR

. . . has extra capacity

Designation: ADL-1000

Features: Unit eliminates the need for a second compressor when only slightly larger air capacity is needed. Compressor should be of interest in small industrial plants or installations where air systems requirements are not heavy.



Specifications: Unit is a two-stage, air-cooled, 20-hp, two-cylinder, vertical compressor. In continuous service this compressor has a piston displacement of 100 cfm, at 870 rpm. Discharge pressure ranges up to 150 psi. On intermittent service, the unit is suitable for discharge pressure as high as 250 psi.

Gardner-Denver Co.
Quincy, Ill.

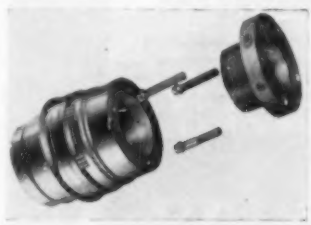
Circle 175 on Reader Service Card

FLEXIBLE COUPLINGS

. . . use taper bushings

Designation: CQD

Features: These couplings have been adapted to taper bushings to



provide reduction of stock requirements of coupling bodies, availability of a wide range of shaft sizes, and coupling bushing combination providing easy fastening to shaft with firmness of a shrunk-on fit.

Specifications: Units are taper-bored, available is six size ranges from 22 to 150 hp at 1750 rpm, with stock bushing bore sizes beginning at ½-in. and progressing to 3½-in. by 1/16-in. increments. Couplings will accommodate standard QD bushings including types SD, SK, SFG, and CE.

Lovejoy Flexible Coupling Co.
Chicago, Ill.

Circle 176 on Reader Service Card

3-WAY SOLENOID VALVE

. . . features small size

Application: These universal type valves have applications as pilot control, remote and automatic control of machinery through single or double-acting air or hydraulic cylinders, regardless of direction of flow or points of pressure application, without change of springs or other adjustments.

Design: Units have three pipe connections and two orifices, with one

always open and one closed. Resilient discs furnish absolutely tight closure on both gases and liquids. Packless construction is provided by enclosing the one-part moving element in a permanently sealed tube. All internal parts are accessible without removing valve body from the pipe line, or disturbing electrical connections.

Automatic Switch Co.
Florham Park, N. J.

Circle 177 on Reader Service Card

GAGE PROTECTOR

. . . effective to 5000 psi

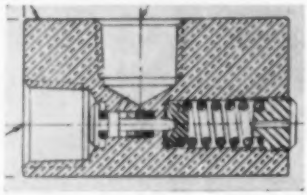
Features: Adjustable gage protector limits maximum pressure on air or oil gages. Protector cuts off flow to gage whenever system pres-

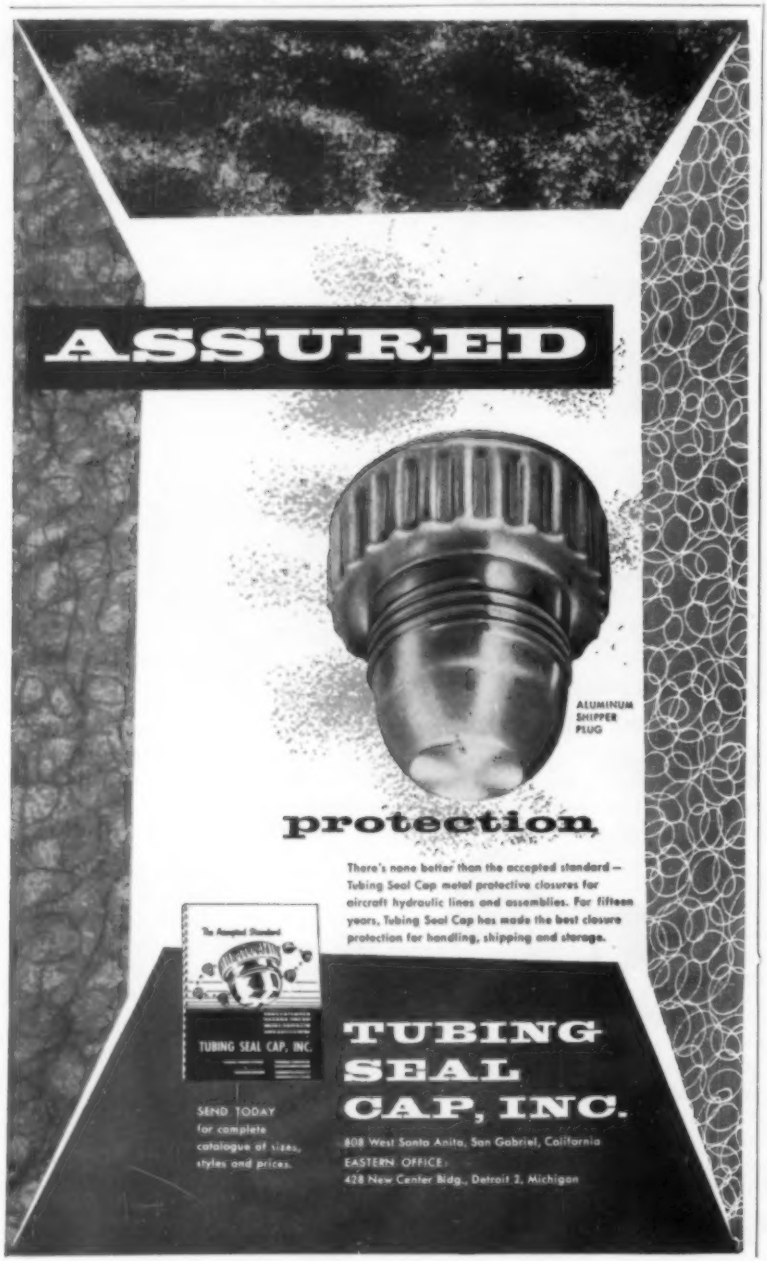
Continued on next page

New Products continued

sure exceeds the spring setting; reopens automatically. It also acts as a snubber to relieve the gage from damaging pressure fluctuations caused by fluid hammer, valve chatter, and pump pulsation.

Specifications: Uses spring-loaded poppet type valve with spring manually adjustable for setting from 50 to 300 psi, or from 500 to 5000 psi. Unit is small, compact, and can be installed in almost any position.




ASSURED
protection
ALUMINUM SHIPPER PLUG
There's none better than the accepted standard — Tubing Seal Cap metal protective closures for aircraft hydraulic lines and assemblies. For fifteen years, Tubing Seal Cap has made the best closure protection for handling, shipping and storage.
TUBING SEAL CAP, INC.
SEND TODAY for complete catalogue of sizes, styles and prices.
TUBING SEAL CAP, INC.
808 West Santa Anita, San Gabriel, California
EASTERN OFFICE:
428 New Center Bldg., Detroit 2, Michigan

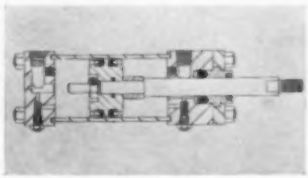
Made of corrosion resistant brass, and equipped with ¼-in. NPT port connections.

Superior Hydraulics Div.
Superior Pipe Specialties Co.
Cleveland, Ohio

Circle 178 on Reader Service Card

SQUARE AIR CYLINDERS
. . . meet JIC Standards

Specifications: Cylinders use U-cup piston packing, chevron rod packing, and rod scraper, all of synthetic rubber. Piston is positively locked on rod with nut and grub screw. Cushion bushing, plunger, and piston are finish-machined after assembly to assure concentricity. Shell is cold-drawn, seamless steel tubing, honed to 15-20 micro inches, either cadmium or hard chrome plated. Piston rod is



high tensile, turned, ground and polished shafting, hard chrome plated .001 on diameter. Rod bearing and cushion bearing are of bearing bronze. Heads are of cold rolled steel. Operating pressure of cylinders is 200 psi, air or oil, with bore sizes 1½ through 10-in. Complete range of mounting styles is available.

Lynair, Inc.
Jackson, Mich.

Circle 179 on Reader Service Card

PRESSURE TRANSDUCER
. . . measures to 15,000 psi

Designation: Model PT32

Application: Designed for situations where large pressures must be measured or recorded with a

minimum alteration of the pressure chamber. Device should have many applications in the fluid power field.

Specifications: Overall accuracy is

Continued on page 160

Why the Leader gives you more!

Because of his laboratories and know-how the leader can give you better design. The leader can afford more efficient tooling and greater quality control.

The leader can give you a better cylinder without a premium price.

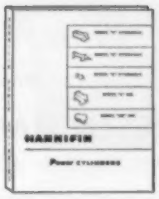
The leader in air and hydraulic cylinders is Hannifin.

AIR AND HYDRAULIC

HANNIFIN

POWER CYLINDERS

Write for your copy of this new Hannifin Cylinder File—complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Hannifin Corporation, 545 South Wolf Road, Des Plaines, Illinois.



Circle 37 on Reader Service Card

RUGGED, HEAVY-DUTY
HYDRAULIC CYLINDERS

Attention: O. E. M.
Prompt delivery on any quantity . . . high quality . . . low cost!

Built-in, Mechanical Stroke Control

Free catalog and engineering survey, no obligation.

WRITE...PHONE...WIRE
CROSS MFG. CO.
LEWIS ■ PHONE 86 ■ KANSAS

New Products continued

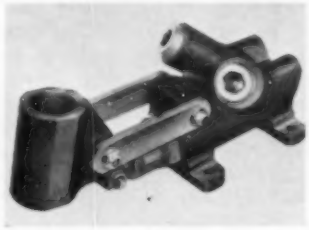
within a total of 1% full scale. Unit operates at temperatures from —65 to 350 F, with temperature effects on sensitivity .005% per degree F. Natural frequency is better than 25,000 cps, while overload protection is 1.25 times full pressure range. Diaphragm OD is 2/10-in., mounting threads are ⅜-24, minimum output is 3.3 millivolts per volt of excitation.

Dynamic Instrument Co.
Cambridge, Mass.

Circle 180 on Reader Service Card

HYDRAULIC HAND PUMP
. . . for 10,000 psi

Specifications: Designed for use with oil, water, or fluids which will not attack cast iron, this pump can be used with dirt laden fluids, and has zero external leakage. Uses standard AN 6201-1 hand pump lever and is available in three options regarding lever position relationship to mounting legs. Lever swings through 60 degrees per stroke, and piston produces less than 25% unswept volume at bottom of stroke. Rated displacement is 2 cubic inches per stroke.



Gladden Products Corp.
Glendale, Calif.

Circle 181 on Reader Service Card

HERRINGBONE GEAR PUMP
. . . delivers 25 gpm at 500 psi

Application: Unit is a heavy-duty, herringbone-gear pump, designed for efficient, economical service in small hydraulic systems, hydraulic lifts, filtration and circulation sys-

DOUBLE SELECTOR VALVE

GRESEN HYDRAULICS

A NEW GRESEN PRODUCT NOW AVAILABLE
Model DS-75

FEATURES: Cast iron body—pressure balanced spool—Easy to mount—Chrome plated spool—Optional three handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range —0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

Write for literature

GRESEN MANUFACTURING CO.
405-35th Ave. N. E. Dept. A-107 Minneapolis 18, Minn.

HYDRAULIC ENGINEERING
FOR INDUSTRY

CARDWELL
TRADEMARK SINCE 1829

DESIGN SERVICES
FABRICATION
POWER UNITS
HYDRAULIC PANELS
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Complete Engineering and Design Services Are Available. Qualified Sales and Service Engineers in Most Areas.

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Quality A CARDWELL TRADITION SINCE 1829
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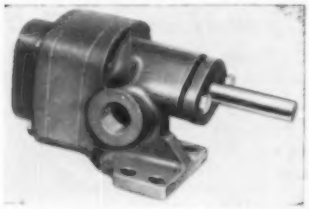
Circle 59 on Reader Service Card

Circle 26 on Reader Service Card

tems, and other applications requiring a low-cost unit for continuous service at pressures to 500 psi, in capacities to 25 gpm.

Specifications: Pump has suction and discharge openings from ½-in. NPT to 1-in. NPT. Construction is simple and rugged, using few operating parts for trouble-free serv-



ice with minimum maintenance. Features include nodular iron, herringbone gears, four forcefeed lubricated roller bearings, replaceable steel-backed, bronze wear plates, and single stuffing box, available with packing or mechanical seal for minimum leakage.

Worthington Corp.
Harrison, N. J.

Circle 182 on Reader Service Card

ONE-WAY SWITCH

. . . gives single impulse

Designation: ES4-DM3

Features: Switch provides simultaneous, one-way action on two poles. One-way action results in an electrical impulse on the inward stroke, and does not operate the switch on return to normal position. Snapaction of the 4-circuit

switch mechanism is independent of plunger movement.

Specifications: The double-pole, double-throw basic switch is housed in an aluminum die-cast case with a splash-proof neoprene boot to protect its switching mechanism. Unit is rated at 15 amps, 125/250 v a-c, 30 v d-c.

Electro Snap Switch & Mfg. Co.
Chicago, Ill.

Circle 183 on Reader Service Card

Continued on page 163

Mr. Plant Engineer–

You're responsible for EFFICIENT air supply to pneumatic equipment

Here are
BRAND NEW
high-efficiency units . . . better air service . . . easier to maintain

Delivers really CLEAN dry air

Watts Filter delivers clean dry air to Federal Products Dimensionair.

High-Efficiency FILTER with exclusive "Tornado Action."

Extreme centrifugal force spirals dirt and moisture particles downward into the "quiet zone" leaving in the air only a minute percentage of the finest and lightest particles which are trapped by the filter cone.

Maintains MORE UNIFORM PRESSURE

Watts Regulator maintains uniform air pressure for Scott-Williams KN Knitting Machine

High-Efficiency REGULATOR with highly sensitive "Aspirator Action."

Watts Aspirator control acts directly on the diaphragm, giving instant compensation for fluctuating pressure demands . . . provides precise control and stabilizes pressures reaching individual pieces of equipment.

LUBRICATES perfectly at all flow rates

Watts Lubricator provides efficient lubrication for Markem Machine Company's Model 70AF.

High-Efficiency LUBRICATOR with exclusive "By-pass pick-up."

Watts new By-Pass Pick-Up makes possible a sub-miniature, high velocity venturi section which positively creates sufficient force — even at flow rates as low as one cubic foot per minute — to vaporize oil into a fine mist for uniform, economical lubrication.

BEFORE YOU MAKE ANY COMMITMENTS –
get the facts on Watts new-design units which open up new worlds of efficiency in Pneumatic Operation, Line Maintenance, and Protection of Equipment against foreign matter.

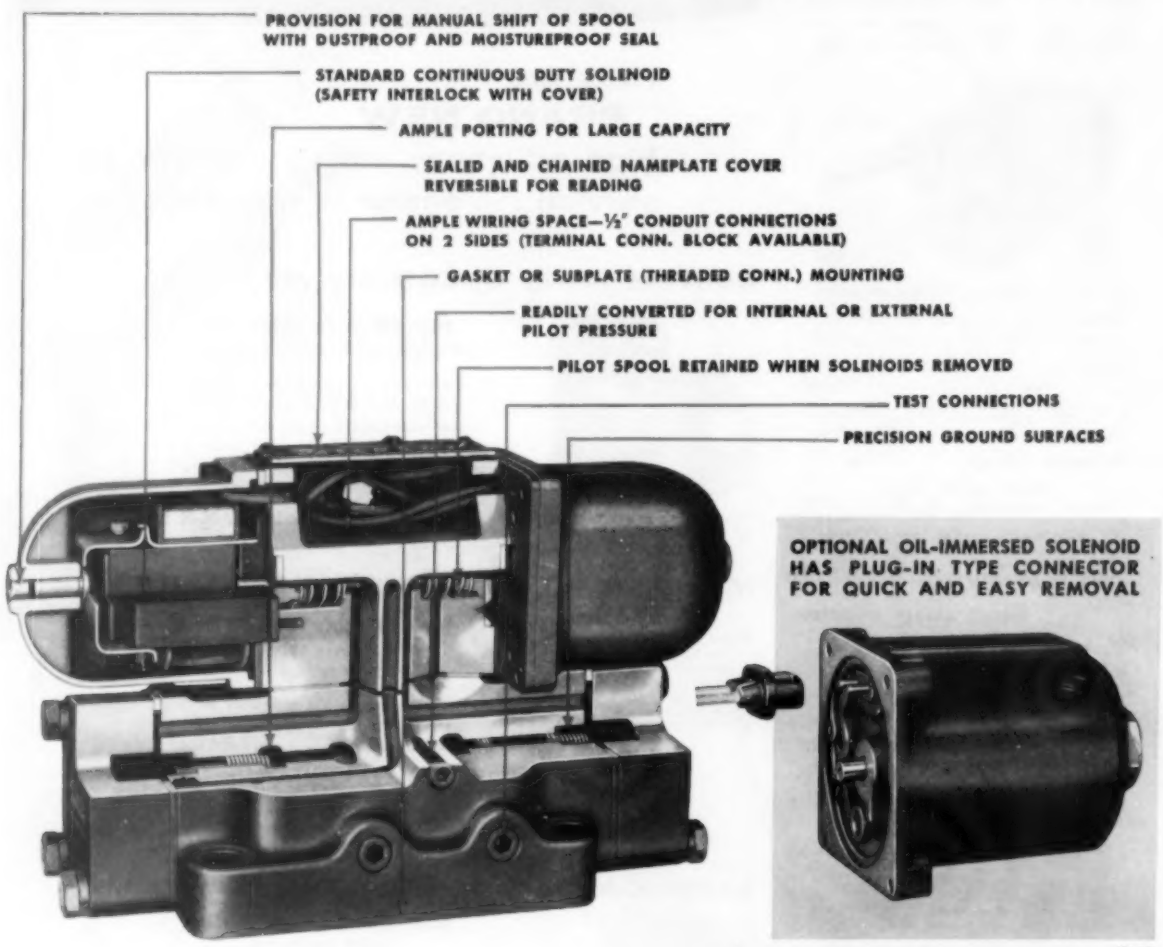
REQUEST CATALOG AND DETAILED SPECIFICATION SHEETS

WATTS REGULATOR COMPANY
SINCE 1875

8 EMBANKMENT ROAD — LAWRENCE, MASSACHUSETTS

Circle 149 on Reader Service Card

Only VICKERS® DIRECTIONAL VALVES Have *All* These Features


PROVISION FOR MANUAL SHIFT OF SPOOL WITH DUSTPROOF AND MOISTUREPROOF SEAL
STANDARD CONTINUOUS DUTY SOLENOID (SAFETY INTERLOCK WITH COVER)
AMPLE PORTING FOR LARGE CAPACITY
SEALED AND CHAINED NAMEPLATE COVER REVERSIBLE FOR READING
AMPLE WIRING SPACE—½" CONDUIT CONNECTIONS ON 2 SIDES (TERMINAL CONN. BLOCK AVAILABLE)
GASKET OR SUBPLATE (THREADED CONN.) MOUNTING
READILY CONVERTED FOR INTERNAL OR EXTERNAL PILOT PRESSURE
PILOT SPOOL RETAINED WHEN SOLENOIDS REMOVED
TEST CONNECTIONS
PRECISION GROUND SURFACES
OPTIONAL OIL-IMMERSED SOLENOID HAS PLUG-IN TYPE CONNECTOR FOR QUICK AND EASY REMOVAL

7897

REDUCED DOWN-TIME
LONGER SOLENOID LIFE
LESS MAINTENANCE
EASIER INSTALLATION

Vickers hydraulic 2- and 4-way valves provide the optimum in directional control. They are compact, versatile, and are designed for heavy duty, continuous and rapid cycling operation on all types of industrial machinery. More than a decade of application experience and years of research and development back all the valves' features.

Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi. Optional oil-immersed solenoids operate cooler, increasing service life 20 to 30 times.

Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models. The optional oil-immersed solenoid has a plug-in type connector and is available in all standard voltages. Field modification of existing units can be made to incorporate heavy-duty, oil-immersed solenoids.

The valves conform to JIC Standards and are available in ⅛" and ¼" direct solenoid operated models . . . ¾", 1¼", 2", and 3" solenoid controlled pilot operated models. These valves cover the flow range from 1.25 gpm to 320 gpm.

For further information, write for Installation Drawing I-182412.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1474 • Detroit 32, Michigan

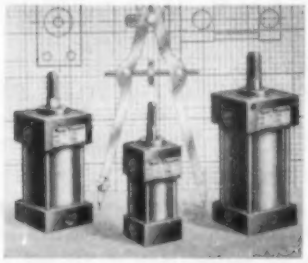
Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.) • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • TULSA WORCESTER
FACTORIES ALSO IN AUSTRALIA, ENGLAND AND GERMANY
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto and Montreal

New Products continued

AIR & OIL CYLINDERS
. . . have 3/4 to 1-1/8-in. bores

Designation: Tom Thumb

Specifications: Units are machine tool quality, designed for small



cylinders with minimum mounting heavy-duty applications requiring dimensions. Field proven for three years, they are manufactured in eight mounting styles. The ¾-in. bore has a ¼-in. rod; 1-in. bore, 5/16-in. rod; and the 1⅛-in. bore, a ⅜-in. rod. Pressure ratings are: air, 200 psi; hydraulic, 2000 psi. Available in any length of stroke required in either double-acting or single-acting, spring-return.

Pneumatic-Hydraulic Development Co., Inc.
Fort Wayne, Ind.

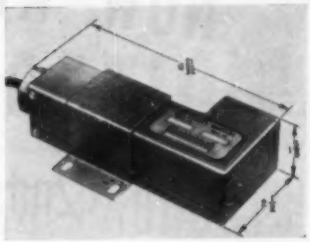
Circle 184 on Reader Service Card

PROXIMITY SWITCH
. . . offers close-mounting

Designation: 2FA1

Design: Unit can be mounted on a surface that extends only 3¼-in. from the material which operates it. Switches are precision static type, without moving parts. Magnetic field set up in front of sensing end detects ferro-magnetic objects. Signal flows through magnetic circuitry to operate a control relay, which may be remotely located. Relay can operate up to 10 times per second.

Specifications: Entire switching element and sensing unit are potted and enclosed within a heavy steel casing for positive operation even in the presence of liquid coolants, or in damp or dusty locations.



Adjustable mounting bracket is furnished. Excitation is by 100-125 v, 60 cps, 2-watt current.

Micro Switch Div.
Minneapolis-Honeywell Regulator Co.
Freeport, Ill.

Circle 185 on Reader Service Card

CONTOUR CUTTERS
. . . for MS33514 & MS16142

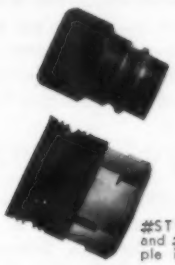
Designation: MS

Specifications: Units are standard, carbide-tipped port contour cutters for profiling MS33514 flareless tube connector contour and MS16142 internal O-ring boss for straight thread tube fittings. Both

Continued on page 166

TRU-FLATE® SUPER FLOW

Straight Through Couplers

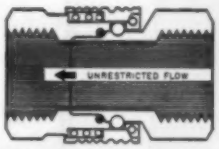


#ST17 coupler and #ST3F nipple illustrated

A complete new series of TRU-FLATE couplers designed to give greater flow with no line pressure drop.

Available in three basic body sizes with mating nipples—female taper pipe threads from ⅛" to 1"

Engineered by "TRU-FLATE", the high quality line of heavy duty "Valve Type" couplers and nipples for air, oil, water, gas, steam, freon, oxygen, etc.



Compare TRU-FLATE with other top quality lines for performance, durability, availability and price.

Write for literature and name of nearest distributor.

TRU-FLATE® INC.

888-92nd AVENUE • OAKLAND 3, CALIFORNIA

Circle 136 on Reader Service Card

A complete packing unit for hydraulic or pneumatic rods or cylinders.

**Detailed literature on request.*

- **Easily installed or replaced.**
- **Needs no adjusting.**
- **Reduces initial machining expense.**
- **Longer service life.**
- **Includes "Seal-Guard" rod wiper.**
- **Low friction coefficient.**
- **Shock and burst proof.**
- **Cuts machine down-time.**

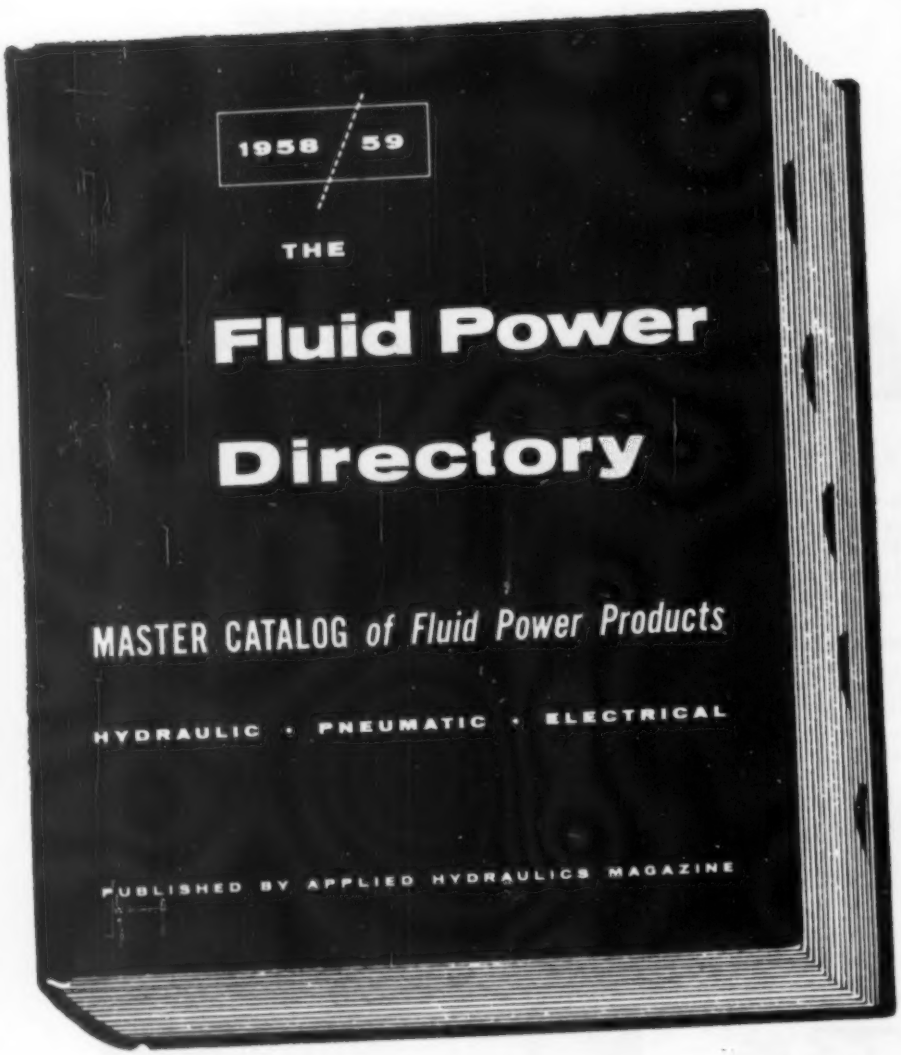
HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

Circle 70 on Reader Service Card

NOW AVAILABLE!

The Complete Guide to . . .

2nd EDITION . . . FLUID POWER DIRECTORY . . . .



SECTION A

FLUID POWER COMPONENTS DIRECTORY—Over 140 pneumatic, hydraulic and electrical products for fluid power systems—from accumulators to wiper rings—are listed in this directory. Listings of advertisers appear in bold face along with the note "See Catalog Section C, pages ——— to ———".

SECTION B

TRADE NAMES—Alphabetical listing of product trade names gives manufacturers' names and addresses. Bold asterisk points out all advertisers in the Directory.

SECTION C

MANUFACTURERS' CATALOGS AND SALES OUTLETS—Manufacturers' advertising is arranged in alphabetical order. An index to these specification ads lists manufacturer's name and address of main plant; names and location of U.S. and Canadian representatives.

SECTION D

FLUID POWER DESIGN—224 pages of engineering reference material is divided into: JIC and ASA Standards, Nomographs, Design Data, Air and Oil Circuits. Product Information, and Applications and Developments.

SECTION E

WHERE TO BUY LOCALLY—The "Yellow Pages" supply information about local fluid component suppliers. Listing is alphabetical by state, city and company name. Advertisers in this section are independent sales companies.

. . . FLUID POWER APPLICATION!

. . . . MASTER CATALOG OF FLUID POWER PRODUCTS

The only complete Hydraulic and Pneumatic Reference

YOUR HANDBOOK FOR FLUID POWER —This biennial volume—the 1958/59 edition—is now available. Since June 1955, the editors of APPLIED HYDRAULICS have been gathering and editing hydraulic and pneumatic information for this book. You will use the new edition of the FLUID POWER DIRECTORY as a time saver for all kinds of information about hydraulics and pneumatics.

The Components Directory Section lists more than 650 companies who manufacture products in the 140 indexed classifications from accumulators to wiper rings.

In this permanently bound volume, more than 150 manufacturers of fluid power components put their specification-type advertising in your hands—many will include condensed catalog information. Your 1958/59 Directory warrants being called the "bible" of fluid power application and engineering.

FOR ENGINEERS WHO USE FLUID POWER —When you're looking for sources of components, or trying to locate the manufacturer of a part for which you have the trade name, or want to quickly locate the local source, or need spec data immediately, it's all in this book. And you have a big PLUS section which is only available in this volume—224 pages of Fluid Power Design information. It includes JIC and ASA Standards, nomographs, charts, product information, over 150 circuits, applications and developments.

UP-TO-DATE INFORMATION —17,500 1958/59 Directories will be put in the hands of men who select fluid power components. A recent survey made to users of the first edition published two years ago shows that each copy is used by more than 5 men. The book is designed for the hard use it gets. It helps every user save time in designing and building fluid powered equipment. Your copy will be your fluid power handbook.

Order your Directory now . . .

$6.50 PER COPY

800 PAGES OF VALUABLE DESIGN INFORMATION

Compiled and Published by

APPLIED HYDRAULICS

The Magazine of Fluid Power

812 HURON ROAD
CLEVELAND 15, OHIO

FLUID POWER DIRECTORY
812 Huron Road, Cleveland 15, Ohio

Please reserve ..... copy (ies) of the 1958/59 edition priced at $6.50 a copy in U. S. A. Postal charges will be made for foreign orders.

☐ Check enclosed ☐ Bill me

Name: ..... Title: .....

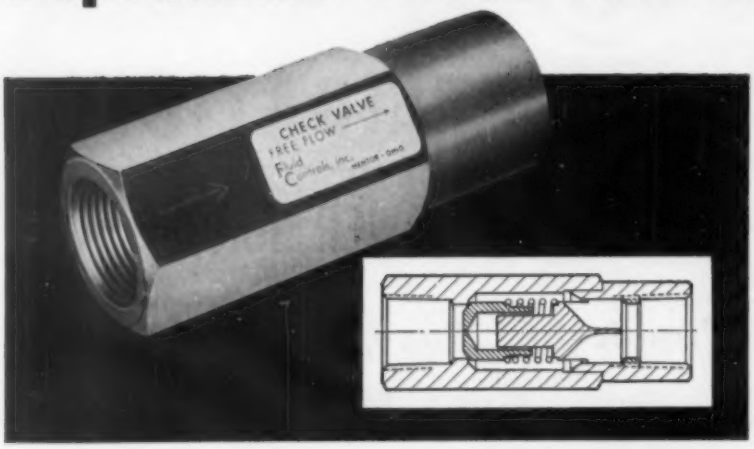
Company: .....

Address: .....

City: ..... Zone: ..... State: .....

Circle 48 on Reader Service Card

Dependable Check Valves



- Can't Stick Open
- Low Pressure Drop
- For Oil
- Copper Brazed Steel Bodies
- To 3000 P.S.I. Service
- Pipe Sizes ¼" thru 1¼"

Write for detailed specifications and prices.

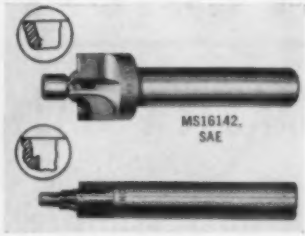
Fluid Controls, inc.
Member of NFPA

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

New Products continued

tools form a complete contour as the tool is fed into a drilled hole. Cutters are available in 13 diame-



ters for all sizes of fittings used with ⅛ through 2-in. dia. tubing.

Sonnet Tool & Mfg. Co.
Hawthorne, Calif.

Circle 186 on Reader Service Card

DIRECTIONAL CONTROL VALVES

. . . provide fine metering

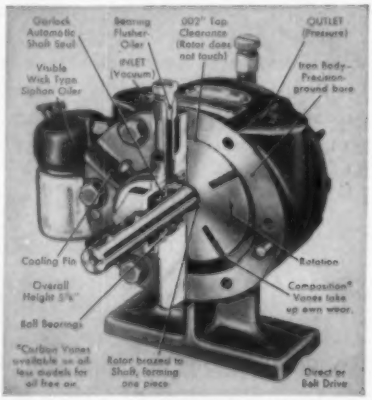
Designation: VDP2

Specifications: Designed for the mobile equipment field, this line of hydraulic directional control valves is nominally rated at 20 gpm. Units are engineered to provide excellent metering character-

INTEGRAL-MOTOR PUMPS
1/12 to 1/3 h.p. to 4 cfm.

LIGHT-DUTY PUMPS
V-belt, direct drive.

HEAVY-DUTY PUMPS
To 21 cfm, 28" vac. or 30 psi.


Garlock Automatic Shaft Seal
Bearing Flusher-Oiler
.002" Top Clearance (Rotor does not touch)
OUTLET (Pressure)
INLET (Vacuum)
Visible Wick Fyon Siphon Oiler
Iron Body—Precision-ground bore
Cooling Fin
Rotation
Overall Height 5⅞"
Composition* Vanes take up own wear.
Ball Bearings
*Carbon Vanes available on all less models for oil free air.
Rotor brazed to Shaft, forming one piece
Direct or Belt Drive

Quality and simplicity keep efficiency high on

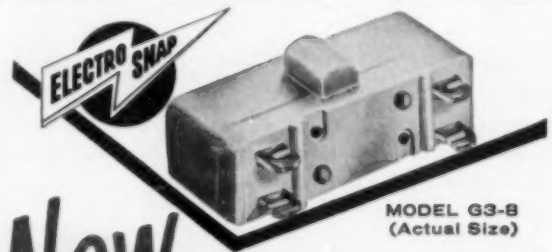
GAST AIR PUMPS

This cutaway reveals why Gast Air Pumps are in demand for plant use and original equipment. Manufactured to high quality-precision standards, all models embody this efficient, simple rotary-vane design. Rotor is balanced; sliding vanes light in weight for minimum motion-energy-friction loss compared to other pumps. As vanes take up their own wear automatically, pump delivers full performance for years.

Write for "Application Ideas" booklet and catalog—mention capacity you need! Gast Manufacturing Corp. P. O. Box 117-D, Benton Harbor, Michigan.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY
• AIR MOTORS TO 4 H.P.
• COMPRESSORS TO 30 P.S.I.
• VACUUM PUMPS TO 28 IN.
See Our Catalog in Sweet's Product Design File



New 40 AMP. BASIC SWITCH

is tiny; has high capacity

Measuring only 1¾" x 43/64" x 43/64", the new Electro-Snap G3-8 Basic Switch handles current ratings up to 40 amps. A new method of combining Electro-Snap's double-break action with a heavy-duty switching element assures electrical and mechanical life of 100,000 cycles at large capacities; also provides constant stability of tolerances and accurate repeatability.

New plastic compound case gives the switch an ambient temperature rating of —65° to +300°F. with extreme shock resistance. Small size makes it ideal for motor controls and compact automation setups. A wide range of actuators is available.

Write for details in Data Sheet GF-11

MODEL G3-8
Single Pole, Double Throw
40 AMPS
@ 125/250 V. A.C.
@ 30 V. D.C. Res.

Oper. Force, 30 ozs.
Overtravel, .025" Min.
Move. Differ.,
.055 ± .010

ELECTRO-SNAP
SWITCH & MFG. CO.
4224 W. Lake St.
CHICAGO 24, ILLINOIS

Circle 54 on Reader Service Card

Circle 45 on Reader Service Card

istics in raising, positioning, rotating, holding or lowering operations and feature exceptionally low pressure drop. Available in 1, 2, 3, 4, and 6-spool models, and operating

at pressures up to 2000 psi. Open-center, parallel circuit design permits independent or simultaneous operation of two or more cylinders or hydraulic motors at one time.

Parker Appliance Co.
Cleveland, Ohio

Circle 187 on Reader Service Card

5-WAY CONTROL VALVE

. . . for hydraulic service

Designation: Model 1776

Features: Designed for more complicated circuits, this valve can be used on materials handling equipment where the hydraulic circuit must operate a hydraulic motor-driven wheel or double-acting stabilizer, in addition to the single-acting lift cylinder.

Design: In center position, the valve connects straight through to the single-acting cylinder with other ports closed. In either of the end positions, it connects to a double-acting cylinder and closes the port to the single-acting cylinder. Standard valve is suitable for pressures to 2000 psi, but special valves can be furnished for higher pressures.

Mechanisms Co.
Uhrichsville, Ohio

Circle 188 on Reader Service Card

Continued on next page

Which V-Rings have the original Vee-Flex® design?

Appearance won't tell—performance will!

DESIGNED FOR EVERY PISTON AND ROD • ROCK-HARD RINGS • POLYMER SATURATED FABRIC • PRECISION TRIMMING • PROPER INTERFERENCE FOR AUTOMATIC SEALING

R/M Vee-Flex is so designed as to be self-sealing and self-adjusting. The surfaces of the rings have a convex curvature where they contact the ring adjacent. The hydraulic pressure stroke produces a seal laterally against the stuffing box wall and longitudinally against the next ring.

Deep, thorough penetration of the compound into the fabric of this top-flight packing enables it to provide maximum resistance to extrusion at high pressures. In addition, it is precision molded for better fit, longer service. Whatever your hydraulic application, you can count on R/M Vee-Flex for perfect performance.

R/M makes a complete line of mechanical packings, including Vee-Flex, Vee-Square, Homogeneous Vee-Rings, and Fabric Piston Cups

For complete information, send for booklet

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

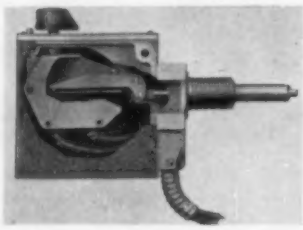
FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

New Products / continued

IMMERSION THERMOSTAT

. . . has high sensitivity



Features: Unit was developed for use where sensitivity to temperature change as low as a fraction of a degree is required, at temperatures up to 300 F. Yet, it is rugged enough to withstand extreme temperatures above or below the calibrated range.

Specifications: Thermal element is composed of a highly expansive metal tube with a low expansive steel rod on the inside. Differential expansion of the two metals operates a snap acting switch, rated at 15 mps, 125 v a-c.

Alloy Bellows, Inc.
Cleveland, Ohio

Circle 189 on Reader Service Card

TEMPERATURE-COMPENSATED VALVE

. . . for accurate flow control

Features: This pressure-compensated flow control valve also corrects for flow variations due to fluid temperature changes. Unit replaces 12 models in the 5 to 1000-cipm flow range.

Design: Average flow variations due to temperature changes have been reduced by approximately 75%. A single adjustable throttle

is used for all flow rates from 5 to 1000 cipm, and allows finer flow rate adjustment throughout this range. This eliminates the possibility of mounting an incorrect valve and reduces stock requirements where multiple flow rates are necessary. New valve has an integral check valve to permit reverse free flow up to 1400 cipm. Design eliminates necessity for external drain. Throttle locking device prevents tampering with control setting.

Vickers, Inc.
Detroit, Mich.

Circle 190 on Reader Service Card

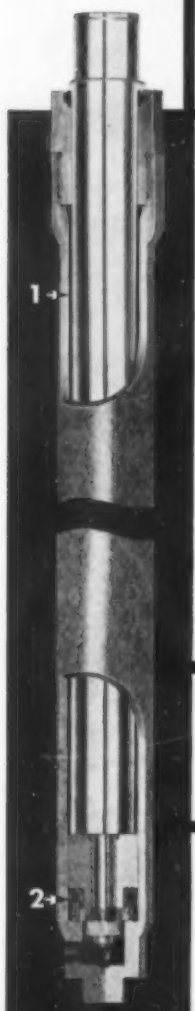
GAGE ISOLATOR

. . . is normally closed

Design: Unit is designed to protect fluid pressure gages from excessive surge pressures, by isolating the

Continued on page 170

Good Design Deserves . . .
BHEW Custom-Built HYDRAULIC CYLINDERS



BHEW custom-built hydraulic cylinders give dependable operational performance wherever they are used. These efficient, close-tolerance cylinders require minimum mounting space; their cost is reasonable; there is no charge for tooling. BHEW builds cylinders to meet your specifications, delivers them on schedule.

BHEW CYLINDER FEATURES:

Standard and special designs available. • Double or single acting and telescopic. • 1½" to 8" bore. • Strokes up to 156". • Smallest possible O. D. and retracted O. A. length. • Oil cylinders with 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi. • Cup-type, ring-type or O-ring construction. • Choice of mounting.

1. **Honed steel cylinder.**
2. **Full double-sealing "U" cup packing.**

Furnished in a wide variety of mountings and anchor brackets.

WRITE for your copy of Hydraulic Cylinder Engineering Reference Data Manual. Can save you hours of time in specifying cylinders. 40 dimensioned basic designs for general and special purpose double acting cylinders.

BHEW BENTON HARBOR ENGINEERING WORKS, INC.
622 LANGLEY AVENUE • ST. JOSEPH, MICHIGAN

Circle 9 on Reader Service Card

3000 psi won't get by the threads of Allen ⬡ Dryseals!

ALLEN 'TRU-ROUND' Dryseal Pipe Plugs

formed from special analysis ALLENOY steels.

Sold only through leading industrial distributors—specify genuine Allen Dryseal Pipe Plugs.

standard sizes from 1/16" to 1-1/4"

Here's the dependable, metal-to-metal seal you need for hydraulic systems . . . for transmission, control, and automated mechanisms where pressures run high. The N.P.T.F. threads of Allen ⬡ Dryseal Pipe Plugs are smooth, burnished, and burr-free — do their job without any help from sealing compounds. Allen's unique "pressur-forming" process assures the highest degree of precision threading and dimensional accuracy. What's more, Allen ⬡ Dryseals are precisely round at root, pitch and crest, with taper held to extremely close tolerances.

Allen engineers will gladly help you to harness your hydraulic pressures. Just write.

ALLEN
MANUFACTURING COMPANY
Hartford 2, Connecticut, U.S.A.

What a sight!

CENTURY'S

All-new Oil Level Sight Gage

- No Easier Installation Ever Designed
- Better Visibility at any Height
- Leak-proof—No Dripping
- Streamlined Modern Appearance
- Important Savings in COST
- Available NOW From STOCK

Send for new catalog containing dimensional information on hydraulic reservoirs and complete line of power unit accessories.

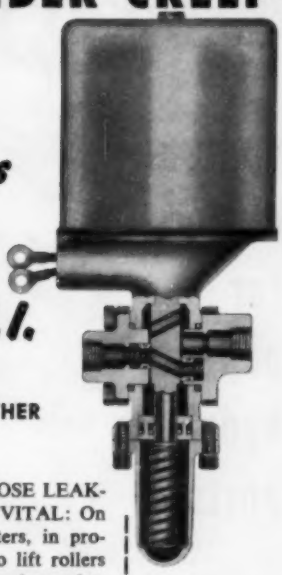
CENTURY HYDRAULICS, INC.
7703 LYNDON AVE. • DETROIT 38, MICHIGAN
Telephone: Diamond 1-3797

Circle 28 on Reader Service Card

STOP CYLINDER CREEP

WITH 'SHEAR SEAL' SOLENOID VALVES

LEAKPROOF AT 3000 P.S.I.



OIL & WATER, 1500 P.S.I. AIR OR OTHER INERT GAS

They are accepted wherever CLOSE LEAKAGE SPECIFICATIONS ARE VITAL: On hydraulic clamps of paper cutters, in propeller pitch control for ships, to lift rollers over seams in textile printing, in rocket charging, in nitrogen and freon charging (refrigeration coils, pressure bottle charging of insecticides and shave cream), as high pressure cut in on presses, on soaking pit doors and lift tables in steel mills, for airblast control on copper converters, on oil well blowout preventers, in test board applications, wherever a valve must be leakproof and stay leakproof.

This is why we don't use SPOOL VALVE DESIGN, they depend on leakage for lubrication, dirt can enter spool clearances, cause binding and coil burnout.

NO STICKING
because the movement of the sealing members does not depend on lubrication, the direct acting solenoid maintains a positive power margin.

LONG, MAINTENANCE-FREE SERVICE
is assured through the lapping action of the Shear-Seals against the slide, which actually improves the sealing qualities of the valve with each operation. The small amount lapped from the Shear-Seals after millions of cycles is compensated by a back-up spring. Dirt or pipe scale cause no damage or failure because the spring keeps the sealing surfaces in constant intimate contact.

This is why we don't use POPPET VALVE DESIGN; dirt in fluid passes over sealing surfaces, acts like a sand blast quickly destroying sealing qualities.

HIGH FLOW CAPACITY
apparent in the straight through flow, unobstructed by spools or poppets, often lets you go to a smaller Shear-Seal valve and still meet the flow requirements.

Write for Catalog 5-S

BARKSDALE VALVES

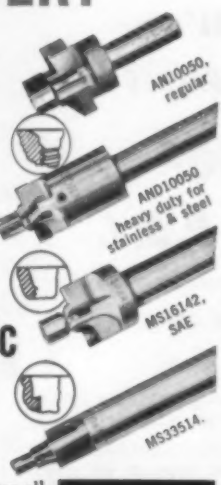
5125 Alcoa Avenue, Los Angeles 58, California

Circle 19 on Reader Service Card

Circle 127 on Reader Service Card

IMMEDIATE DELIVERY

contour cutters for popular hydraulic ports!



One pass completes all operations necessary to produce the port contour. Job time cut as much as ⅔! All have carbide cutting edges for long life, smooth finishes. Available in all sizes. Write for prices.

SONNET
Tool and Mfg. Co.
576 North
Prairie Avenue
Hawthorne
California

New Products continued

gage from the system except when readings are being taken. Device is spring-loaded.

Specifications: Built for operating

pressures up to 5000 psi, equipped with ¼-in. NPT ports and holes for panel or bracket mounting, isolator is small and light and can be installed in any position in any hydraulic circuit.

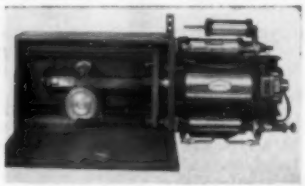
Sarasota Precision Products, Inc. Sarasota, Fla.

Circle 191 on Reader Service Card

POWER FEED UNIT
. . . is air-motor driven

Designation: Hy-Torque

Design: Unit is designed to power the feed on multiple drilling applications and similar equipment. Basic unit consists of a steel gear rack driving a pinion gear mounted

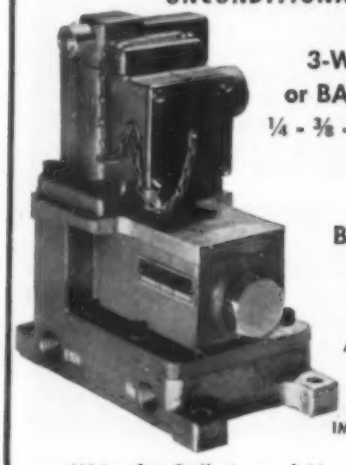


on a shaft with a hub as the drive unit. A 4½-in. bore air motor advances the gear rack with a thrust of 15 times applied air line pressure. Two checks govern feed rate and balance hydraulic reaction during feed portion of stroke.

Specifications: 3000 in-lbs maximum torque is delivered at the hub. This torque may be applied

Solenoid Operated AIR VALVES
conform to all J.I.C. Standards

Stop Your Solenoid Troubles with **AV VALVES**
Designed & Engineered for Many, Many Millions of Trouble Free Operations & Backed by 1 Year **UNCONDITIONAL GUARANTEE**



3-WAY IN-LINE
or BASE MOUNTED
¼ - ⅜ - ½ - ¾ - 1 - 1¼

• • • •

4-WAY
BASE MOUNTED
¼ - ⅜ - ½ - ¾

COMPLETE LINE OF AIR CONTROL VALVES

STOCKING REPRESENTATIVES IN IMPORTANT INDUSTRIAL CENTERS

Write for Bulletin and New Low Prices

AUTOMATIC VALVE CO.
37419 GRAND RIVER AVE., FARMINGTON, MICH.

Circle 17 on Reader Service Card

TRU-O-SEAL STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

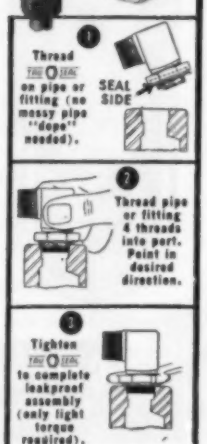
$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

TRU-O-SEAL DIVISION
Flick-Reedy Corp

2008 N. Hawthorne, Melrose Park, Illinois
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

Circle 137 on Reader Service Card

to any crossfeed shaft or driven shaft for rotational or linear movement. Four standard models provide choice of degree of rotation of the 4-in. pitch dia. pinion gear.

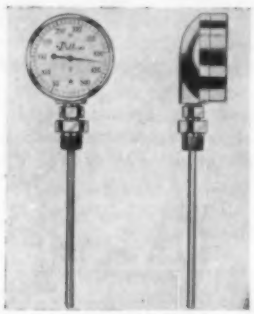
The Bellows Co.
Akron, Ohio

Circle 192 on Reader Service Card

STRAIGHT FORM THERMOMETER

. . . is easy to read

Features: Unit has an adjustable mounting nut to turn and lock the head in position for maximum visibility. Straight form type of construction is well adapted to installations on top of oil reservoirs,



tanks, in high locations or other areas which cannot use a standard angle form unit.

Specifications: Thermometers are made in 3 and 5-in. head sizes and can be supplied in stem lengths from 2½ to 72-in. with all intermediate steps. Head is heavy casting, finished in gray with chromium plated bezel. Standard installation is made with a ½-in. NPT mounting nut. Ranges cover from —40 F to 1000 F. Accuracy within 1% of the range over the entire scale.

W. C. Dillon & Co., Inc.
Van Nuys, Calif.

Circle 193 on Reader Service Card

AIR CONTROL UNIT

. . . regulates, filters, lubricates

Features: Unit is a complete package unit for compressed air operations, regulating pressure, filtering water and dirt from the line, and providing fog-like lubrication.

Design: Regulator operates on a balanced piston principle. Automatic bleed-off permits sensitive pressure reduction without bleeding downstream. Cyclonic action in filter bowl removes dirt and water.

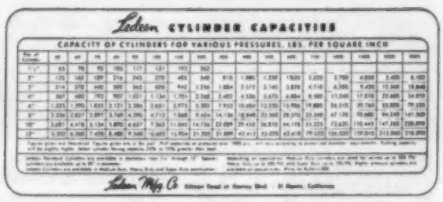
Continued on next page

NEED A CYLINDER?

Ledeen Stocks Them or Builds Them to Fit Almost Any Application

For normal applications requiring standard cylinders or for those unusual applications where a special cylinder is needed, see Ledeen.

Let us know the type of job to be done and how much cylinder power you need. Send for this handy cylinder capacity chart.



Write for Bulletin 500

VALVES • CYLINDERS
VALVE ACTUATORS
AIR-HYDRAULIC PUMPS
AND TEST STANDS

Ledeen Mfg. Co.
3332 North Gilman Road
El Monte, California

Circle 84 on Reader Service Card

New Products continued

Second filtering as air passes through filter cartridge. External oil adjustment meters lubricant which enters air stream as a mist. Special filler button valve permits refilling oil reservoir without stopping operation or shutting off air supply.

Perfecting Service Co.
Charlotte, N. C.

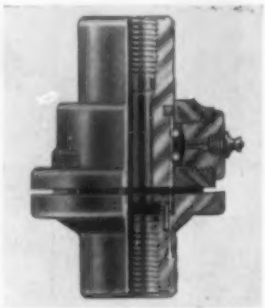
Circle 194 on Reader Service Card

SWIVEL JOINT
. . . permits easy packing change

Designation: Discpak

Design: This swivel joint permits packing units to be replaced without removing the unit from the line. The outer housing of the joint is cut apart at the packing chamber and both ends are flanged at the cut. This permits the joint to be parted at the packing chamber where the disc-type packing seal is located.

Specifications: Discpak has a maximum temperature rating of 600 F



and a maximum pressure rating of 300 psi. It is available in sizes of ⅜, ½, ¾ and 1-in.

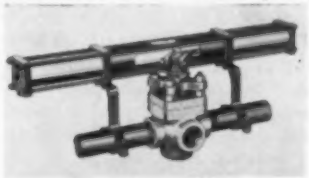
Chikson Co.
Subs. Food Machinery & Chemical Corp.
Brea, Calif.

Circle 195 on Reader Service Card

PLUG VALVE OPERATORS
. . . control wide range

Application: Designed for hydraulic or pneumatic service at pressures up to 200 psi, these medium duty plug valve operators are adaptable to a wide range of control requirements, including process cycling, safety and automatic shut-offs, or any combination of these requirements.

Specifications: Three models are available: FM, for relatively low



torques. Floating bar type operator uses two single-acting cylinders. TM, for higher torques. Uses two double-acting cylinders. QM, for high torque requirements. Consists of two Model FM or TM operators mounted on common bracket. Line offers torque range up to 94,000-in.-lbs.

Ledeen Mfg. Co.
El Monte, Calif.

Circle 196 on Reader Service Card

IT COSTS LESS TO USE THE BEST!

PLS

For your convenience: available in handy 1-lb. brush top cans.

1. High lead content provides positive damming action to assure a perfect seal in the handling of all petroleum base and non-flammable fluids, except those with ester base.
2. Handles high pressures up to 6000 psi.
3. Never washes out—one application lasts forever.
4. Never hardens: joints may be easily broken after years of service—no damaged connections.

Prove it to yourself. Send for a free sample. Crane Packing Co., 6405 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., N. Hamilton, Ont.

CRANE PACKING COMPANY

MAXIMUM CONTROL WITH MINIMUM PRESSURE DROP

270 SERIES

BAR STOCK VALVES

This flow curve for air at 30 psi shows the excellent control obtainable with minimum pressure drop in Hoke's 270 Series bar stock needle valves. The O-ring stem seal will pass a helium leak test... and there's no packing adjustment, no friction even at high pressures. Self aligning stem shuts off tight. For hydraulic and pneumatic equipment, gas analysis, pilot plants, test instruments of all types. ⅛" to ½" pipe sizes in carbon, chrome or stainless steel and brass.

HOKE

HOKE INCORPORATED
Fluid Control Specialists
187 S. Dean Street, Englewood, N.J.

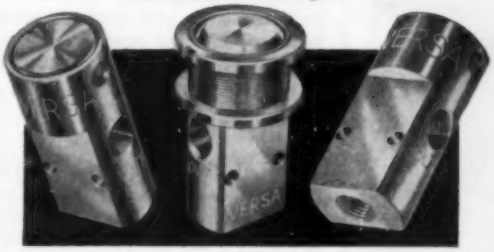
Circle 36 on Reader Service Card

Circle 65 on Reader Service Card

Circle 143 on Reader Service Card

Versa "A" Valves

Give MAXIMUM Capacity In MINIMUM Space...



- Versa solves the space problem with a truly economic valve.
- The overall size of the Versa "A" valve is only 2" high by 1" in diameter, yet it has the capacity of much larger valves.
- Ideal for controlling cylinders, instruments and larger pilot valves.
- Available in 1/8" NPT in 2-way & 3-way types with or without button guard, in either normally open or closed models.
- Simple to mount on equipment or can be furnished for panel mounting.
- Prices range from $4.00 to $6.50 each. For complete information write today for Folder #148.

VERSA

VERSA PRODUCTS COMPANY INC.
248A SCHOLES STREET, BROOKLYN 6, N.Y.

FREE CATALOG! Write today for your free copy of Versa's Catalog #14.

STOP NOISE-Positively

with **BURGESS-MANNING SNUBBERS**

They are engineered to your requirements with GUARANTEED results.

They are available together with spark arresting—water separating —or, heat recovery. They provide noteworthy savings thru no maintenance, as well as greater equipment efficiency and effectiveness. Also, consider Burgess-Manning Snubbers for your Intake Silencing Requirements.

Present your problems for Recommendations.

BURGESS-MANNING COMPANY

Sound Engineering **769 East Park Avenue, Libertyville, Illinois**
Dallas, Texas

Circle 24 on Reader Service Card

This Adams CYCLONE Saves You MONEY!

The Aftercooler and Separator that assures

DRIER Compressed Air

Here's real teamwork! First, the Adams Aftercooler brings the compressed air temperature down — within 10 of the cooling water — where it holds almost 40% less moisture than air from conventional units.

Then, the Adams Separator creates a cyclone to efficiently remove the condensate . . . giving you cooler, drier air for your system.

Thousands in use throughout industry. It will pay you to find out all the details. Mail the coupon below today.

R. P. ADAMS CO., Inc.

Buffalo 17, New York

N-57

R. P. ADAMS CO., INC.
249 East Park Drive
Buffalo 17, N. Y.

Please send my FREE copy of Bulletin #711 on Adams Cyclone Separators and Aftercoolers.

Name..... Firm.....

Street..... City..... State.....

Circle 3 on Reader Service Card

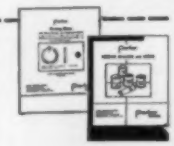
Prove by comparison tests that Parker O-rings seal better, last longer

Comparison tests will prove it. You can't *see* the difference. You can't *feel* it. But in *use*, Parker O-rings seal better, last longer.

Why? Because Parker O-rings are precision-molded of superior compounds developed by exhaustive research and experimentation. Our engineering service will help with your problems — whether in gland design or compound. From Parker, you get the *right* O-ring for your *specific* application.

These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Exacting laboratory and service tests make sure that Parker O-rings meet applicable specifications. Whatever your requirements, Parker can supply the O-rings you need.

Parker O-Lube is especially formulated for O-ring lubrication requirements. It comes in a handy, squeeze-tube container.



RUBBER PRODUCTS DIVISION, Section 526-B,
The Parker Appliance Company,
17325 Euclid Avenue,
Cleveland 12, Ohio.
1538 South Eastern Ave.,
Los Angeles, Cal.

Please send:

☐ O-ring Size Catalog No. 5701
☐ O-Lube Catalog No. 5840

NAME_____ TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____

Parker
Hydraulic and fluid system components

Useful Literature / continued

HOSE TEMPERATURE DATA . . . are covered in a 12-page brochure released by Resistoflex Corp., Roseland, N. J. Booklet gives information concerning chemically-resistant, high and medium temperature hose and hose assemblies, along with complete specifications and technical data.

Circle 255 on Reader Service Card

HYDRAULIC VALVES . . . are illustrated and described in 16-page catalog No. 551, released by Fluid Controls, Inc., Mentor, Ohio. Booklet covers relief valves, check valves, and flow control valves. Each type valve, available for off-the-shelf delivery, is illustrated with detailed engineering drawing showing construction, location of ports, etc. Sizes and performance data are included for each style in convenient, easy-to-read fashion.

Circle 256 on Reader Service Card

POWER UNITS . . . of the electric-hydraulic and air-hydraulic types are described and illustrated in a color brochure available from Hi-Shear Rivet Tool Co., Torrance, Calif. Flow charts are included for both units.

Circle 257 on Reader Service Card

SHUT-OFF VALVE . . . for air, water, or oil service, manufactured by Homestead Valve Mfg. Co., Coraopolis, Pa. Bulletin 39-8 covers its features, including positive seating by spring and line pressure; replaceable resilient disc for positive seal, full opening or closing by 90° movement of handle, cam to hold handle in open position, and vertical or horizontal position of handle indicating whether valve is open.

Circle 258 on Reader Service Card

CLIMATIZED MOTORS . . . open drip-proof, electric type, manufactured by Louis Allis Co., Milwaukee, Wis., are covered in Bulletin No. 2050. Bulletin stresses such motor features as a "climatized" enclosure that provides all-weather security, improved thrust bearing design, metered lubrication and a protected bearing system. Installation and maintenance time-reducing features are illustrated.

Circle 259 on Reader Service Card

Continued on page 176

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CLEVELAND, OHIO

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Street _____

City _____ Zone _____ State _____

PLEASE SEND ME ADDITIONAL INFORMATION AND LITERATURE ON ITEMS CIRCLED BELOW.

1	18	35	52	69	86	103	120	137	154	171	188	205	222	239	256	273	290	307	324
2	19	36	53	70	87	104	121	138	155	172	189	206	223	240	257	274	291	308	325
3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	33.
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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Company _____ Kind of Business _____

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PLEASE SEND ME ADDITIONAL INFORMATION AND LITERATURE ON ITEMS CIRCLED BELOW

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6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
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12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	337
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

New Parker No-Skive Hoze-lok

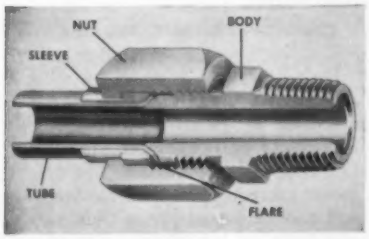
FASTER . . . EASIER . . . RE-USABLE

No more frustrating jobs of stripping off the covers of hydraulic wire-braid, rubber-covered hose! No more ragged hose ends that refuse to enter fitting sockets!

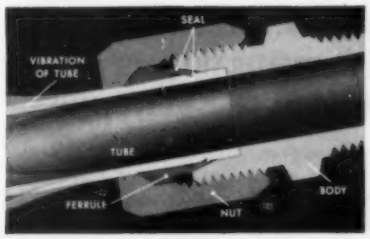
New Parker Hoze-lok Fittings save you all this time and trouble. Skiving of hose covers is *not* necessary. Simply screw the hose (with cover intact) into the socket and then screw the nipple in to complete the make-up. What could be easier . . . or more effective?

Versatile Hoze-lok Fittings are re-usable . . . an important benefit to users of your equipment. Select your fittings from the new series of Hoze-lok styles and sizes, with four different connecting ends and full range of adapters.

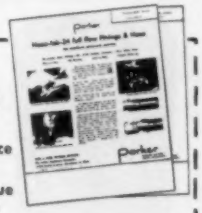
Ask your Parker Distributor or mail this coupon today for catalog about Parker Hoze-lok Fittings and for details about Parker Triple-lok and Ferulok.



Triple-lok Flare Fittings . . . the easiest, fastest, safest way to tube up even in close quarters. Leakproof even under severe vibration, high pressures. Meet S.A.E. Hydraulic Tube Fittings Standard.



Ferulok Flareless Fittings for high-pressure, heavy-wall tubing. Double seal makes Ferulok leakproof, vibration-proof. You can see the "bite." Meet S.A.E. Hydraulic Flareless Tube Fittings Standard.



TUBE AND HOSE FITTINGS DIVISION
Section 429-B
The Parker Appliance Company
17325 Euclid Avenue
Cleveland 12, Ohio

Please send:

- ☐ *Hoze-lok* Catalogs 4433, 4434
- ☐ *Triple-lok* Catalog 4310
- ☐ *Ferulok* Catalog 4320

Name_____
Title_____
Company_____
Address_____
City_____ State_____

Parker
Hydraulic and fluid system components

Circle 105 on Reader Service Card

Useful Literature continued

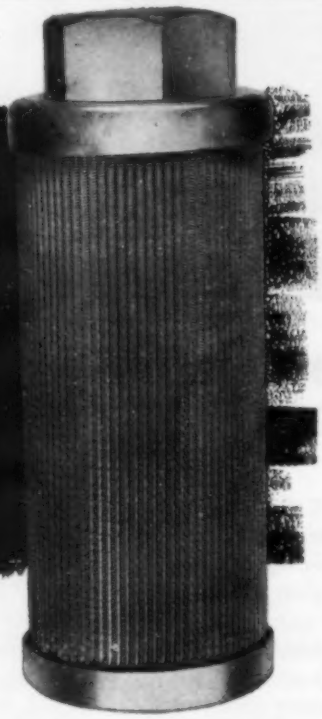
PRESSURE GAGES . . . suitable for industrial, processing and chemical applications are graphically described and illustrated in 32 page catalog G-52, Helicoid Gage Div., American Chain & Cable Co., Inc., Bridgeport, Conn. Engineering information describing how the gages work, types of systems, adjustments, applications, dimensional drawings, specifications, and accessories are given in addition to a listing of recommended uses.

Circle 260 on Reader Service Card

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

PRECISION TEST GAGES . . . developed by Martin-Decker Corp., Long Beach, Calif., are illustrated and described in Bulletin M-28. Information given covers an improved technique in the manufacture of the Bourdon tube, coupled with an advanced design movement, which makes possible a 360° calibration. Unit permits readings up to 15,000 psi, with sizes ranging from 60 psi to 15,000 psi.

Circle 261 on Reader Service Card

RUBBER BONDING PROCESS . . . Bonding of molded mechanical rubber to metal (including aluminum), compounding of rubber for tailor-made jobs, and uses of metals when cushioned with rubber where metal-on-metal cannot be used, are described in a new 24-page, illustrated booklet available from Henry Engineering Co., Moline, Ill.

Circle 262 on Reader Service Card

SEALING COMPOUND . . . forming permanently insoluble joints, is produced by Michigan Chrome & Chemical Co., Detroit. Available bulletin gives specifications and application information.

Circle 263 on Reader Service Card

PISTON RINGS . . . for hydraulic applications, are manufactured by Grover Piston Ring Co., Milwaukee, Wis. Six-page folder tells how and why permanence and leakproof performance are assured by Permaseal piston rings in standard and special hydraulic applications. Fluid power engineers will be interested in the facts and specifications section.

Circle 264 on Reader Service Card

AIR & OIL CYLINDERS . . . are described in 16 page catalog No. 100 issued by Logansport Machine Co., Inc., Logansport, Ind. The cylinders are equipped with hardened and chrome plated piston rods, and are built in fourteen different mounting sizes from 1½ to 8-in. Operating pressures are 150 psi air or 300 psi oil. Included are: photos, dimensional drawings, specification tables, and local dealer listings.

Circle 265 on Reader Service Card

AIR & OIL FILTERS . . . for hydraulic and pneumatic systems are described and illustrated in Bul-

For dependable carefree operation

PRECISION-MADE
MODRICH FLUID
CONTROLS

- Modrich Check Valves
- Modrich Flow Control Valves
- Modrich Needle Valves

All Modrich Fluid Control Valves are superbly designed to conform to J.I.C. Standards—for Air, Oil or Water Hydraulic applications in sizes from 1/8" to 3/4".

Valve bodies are machined from hexagon bars of brass or aluminum for 2,000 p.s.i. working pressures. Steel and Stainless steel for 5000 p.s.i. Finest quality components—yet economical in price. Stocked by leading distributors in principal cities for fastest deliveries. **Send for catalog and quotations.**

Modrich
FLUID CONTROLS, INC.
CRYSTAL LAKE, ILLINOIS

Circle 96 on Reader Service Card

letin No. 17, issued by Filtros, Inc., East Rochester, N. Y. Sketches give applications and suggestions for use. Features covered include high efficiency, long life, easy cleaning, and corrosion resistance.

Circle 266 on Reader Service Card

CIRCUIT IDEAS . . . are given in Catalog 262 issued by Hanna Engineering Works, Chicago. "Idea starter" control circuits are shown on the last page. One circuit is manual with built in safety feature keeping operator's hands out of the way. Another circuit shows automatic reciprocating control. Catalog gives specifications and data on the Flo-Pilot two and three-way air valves for air operation at pressures up to 150 psi.

Circle 267 on Reader Service Card

AIR DRIERS . . . manufactured by Van Products Co., Erie, Pa., are covered in Catalog D1-957NE10. Booklet gives valuable information on moisture-control for compressed air circuits. Also included are dew-point graph, operating capacity and sizing graphs, and complete specifications on these units.

Circle 268 on Reader Service Card

MASTER-SLAVE UNIT . . . is described in a bulletin from Crown Controls Division of Trimount Instrument Co., Chicago. Their latest Hydra-Trol remote control has a positive stroke in both directions. It therefore offers immediate synchronization of the hydraulic control system in either direction. It is self contained and does not depend on either outside power or spring return.

Circle 269 on Reader Service Card

AUTOMATING WITH AIR . . . is described in a 15-page booklet issued by A. Schrader's Son Div., Scovill Mfg. Co., Inc., Brooklyn. Booklet gives illustrated examples suggesting ways for automating manufacturing operations through the use of pneumatics.

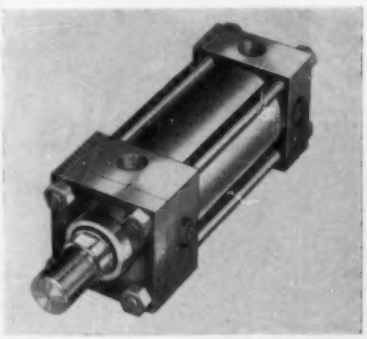
Circle 270 on Reader Service Card

HYDRAULIC RELAY . . . using the principle of jet stream relay, is described in Bulletin 1-001 available from The North American Mfg. Co., Cleveland. Operating principle of the unit is described and illustrated with cutaways.

Circle 271 on Reader Service Card

For dependable carefree operation

PRECISION-MADE MO-BAR
CYLINDERS
200 PSI Air
2,000 to 3,000 PSI Hydraulic
1½" to 14" bore



Conform to J.I.C. Standards

SEALS—self-regulating, minimum friction at all pressures

CYLINDER BARRELS—cold rolled steel tubing, true-bored and honed

END CAPS—MOUNTINGS—bar stock steel precision machined

ROD BEARINGS—bronze; pilot fitted providing accurate rod support

PISTON RODS—turned, hardened, ground, polished and hard chrome plated for longer rod-seal life

Specify Mo-Bar for superb performance—and maintenance-free operation!

Request free catalog.

Mo-Bar
HYDRAULIC SALES, INC.
CRYSTAL LAKE, ILLINOIS

Circle 94 on Reader Service Card

Post Scripts of Industry

News about people, manufacturers and sales organizations

Lester C. Becher
Weatherhead Co.

Andrew M. Damer
John Spotton Co. Ltd.

Richard O. Gordon
Vickers, Inc.

Weatherhead Co., Cleveland, appointed **Lester C. Becher** eastern sales manager for aircraft and ordnance, with headquarters at Wayne, Pa. His territory will include New England, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia and Washington, D. C.

Robert E. Thomas has been named general sales manager of **Cleveland Cap Screw Co.,** Cleveland, a subsidiary of Standard Pressed Steel Co., Jenkintown, Pa.

Ernest R. Freeberg was elected president and general manager of the **Eagle Signal Corp.,** Moline, Ill., and its wholly-owned subsidiary the **Hagen Mfg. Co.,** Inc., Baraboo, Wis. Freeberg was also appointed as a director of each of the companies.

Andrew M. Damer has been appointed sales manager for **John Spotton Co. Ltd,** Toronto, Canada.

Richard O. Gordon, has joined the mobile hydraulics division of **Vickers, Inc.,** Detroit. **William A. Hagerty** was appointed industrial application engineer in the Philadelphia office. **Robert F. Richards** was added as an industrial application engineer on the Chicago office staff.

Donald W. Reagan has been named Los Angeles district manager for **B. F. Goodrich Industrial Products Co.,** Akron, Ohio.

Racine Hydraulics & Machinery, Inc., announced that these dealers would also represent the SECO lines of hydraulic equipment made by their recently acquired subsidiary, **Simplex Engineering Co.,** Zanesville, Ohio; **DeShazo & Thomas,** Birmingham, Ala.; **Landes, Zachery & Peterson,** Denver, Colo.; **J. E. Dilworth Co.,** Memphis, Tenn.; **Hydraulic & Air Equipment Co.,** Portland, Ore.; **Tridel Equipment Ltd,** Vancouver, B. C.; and **Garrett Burgess; Inc.,** Detroit.

Republic Mfg. Co., Cleveland, announced that two more of their sales outlets have become stocking distributors: **Persingers, Inc.,** 520 Elizabeth St., Charleston 27, W. Va.; and **Whitehead Metal Products, Inc.,** Buffalo, N.Y.

Southeastern Plastics Sales Co., Atlanta, Ga., has been named plastics distributor for **Resistoflex Corp.,** Roseland, N. J. They will serve Resistoflex customers in Virginia, North Carolina, South Carolina, Alabama, Florida and Georgia.

Continued on page 180

. . . Fluid Power news

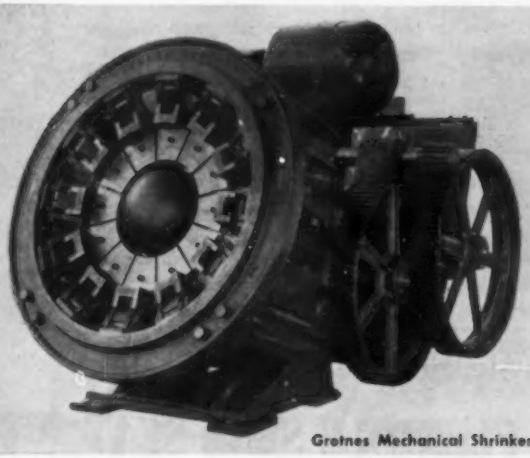
REPORT NO. 11,601
GREATER POWER FOR EXPANDERS — SHRINKERS

From Oilgear Application-Engineering Files

HOW OILGEAR HEAVY-DUTY POWER-PAKS EXTENDED WORKING RANGE OF GROTNES MACHINES

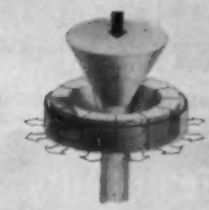
CUSTOMER: *The Grotnes Machine Works, Chicago, Illinois.*

DATA: Grotnes expanders and shrinkers are used for forming and sizing sheet metal parts and heavy rings to tolerances of ±.002″ without heat, machining, or waste. Any continuous cross-section part (square, round, oval, etc.) is expanded over jaws mounted in a slotted table. The jaws are moved radially outward by a drawbar-actuated cone, forming or sizing the part by stressing the metal beyond its yield point to induce a permanent set. In shrinking, the jaws are forced inward against the part by a tapered ring or toggle links. World-wide acceptance of this unique method has led to industrial requests for Grotnes machines with greater working forces, longer strokes, more uniform power than are practical or possible with mechanical drives using gear trains and crankshafts.

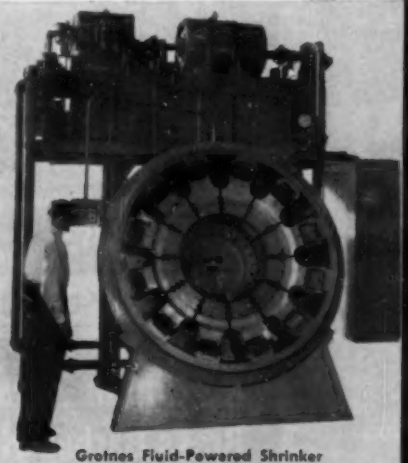


Grotnes Mechanical Shrinker

Grotnes Shrinking Method



Grotnes Expanding Method



Grotnes Fluid-Powered Shrinker

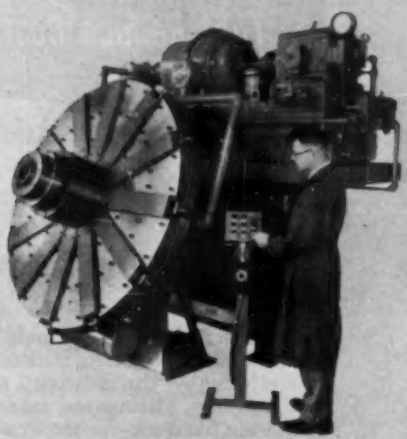
SOLUTION: Shown above are two Grotnes shrinkers—one mechanically powered, the other Oilgear Fluid Powered for greater tonnage, longer stroke, more uniform power. Note the neat appearance of this new unit with its convenient, simple panel for precise, automatic control. Shown, right, is one of a new line of Grotnes expanders designed specifically for Fluid Power operation. Capacities range up to 1,580 tons on the new expanders; to 800 tons on the new shrinkers—based on 3,000 psi pressure provided by Oilgear application-engineered Heavy-Duty Power-Paks. Performance and control on these new, larger machines has been so outstanding that Grotnes is now equipping expanders as small as 25 tons drawbar pull with Oilgear Power-Paks. This is just one example of Oilgear cooperation and teamwork with designers and builders of machines for industry. An Oilgear Power-Pak is more than just a clean-appearing, unitized assembly of a pump, motor, reservoir, valves and controls . . . it is an efficient, leaktight, easy-to-install, Heavy-Duty Fluid Power system based on over 35 years of pioneering-engineering-knowledge that provides: automatic, electric power conservation; precision-controlled pressures, positions, cycle times; dependable operation; unit responsibility for the entire power system. Because of Oilgear's long reputation for dependable, trouble-free Fluid Power for virtually any application, Oilgear has become a name that all industry trusts . . . and uses.

For practical solutions to your linear or rotary drive and control problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to:

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1564 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN



Grotnes Fluid-Powered Expander

Oilgear application-engineered Power-Paks are also used extensively on hotplate, plywood, pulp-baling, injection molding, extruding, forming, and other presses. Oilgear rotary drive and control systems are equally well accepted in virtually every field of manufacturing and processing. For accurately controlled linear or rotary power . . . for the lowest cost per year . . . check with Oilgear!

Circle 2 on Reader Service Card

Here's the ring that gets all the dirt . . . wipes the piston rod CLEAN with every stroke—leaves no tattle-tale streak because it has no open joint.

Spring-Loaded, it has **"Squeeze Grip Action,"** assuring new ring performance . . . automatically takes up the wear. Dry-Lapped at the factory, its wiper edge assures true circle contact . . . Seals Out dirt and even liquids when certain of our rubber seal features are added to the metal portion of ring.

Be sure to specify FALL Wiper Rings, FALL "CJ" Wiper Rings with the closed joint. Available in bronze, stainless steel, cast iron in sizes from 5/16" to 12" dia. If you have a wiper ring problem get in touch with us.

All Fall Rings covered by patents issued or patents pending.

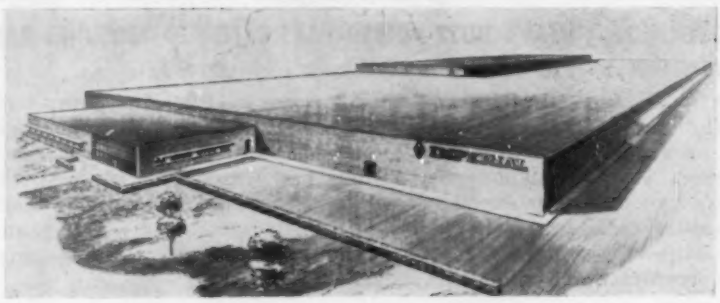
Ace Products Co.

Toledo 1, Ohio Phone Cherry 3-8818

Fall Wiper Ring SPRING LOADED

You Can Depend on ACE PRODUCTS —Established 1935!

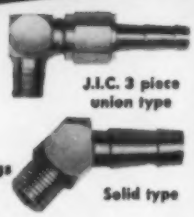
Post Scripts of Industry continued



A completely integrated tube fitting and tubing tool manufacturing facility has been placed in operation at Niles, Ill -(Chicago) by **Imperial Brass Mfg. Co.** Containing the most advanced equipment available, the structure houses the executive and sales offices, as well as all its manufacturing facilities. **F. C. Shafer,** president, announced that the move combined the various divisions under one roof, and changed over production to the new integrated lines without a single lost day of production. Additional area is available for expansion and parking area. Manufacturing facilities have been engineered to provide for continual feed-in and progressive flow in manufacturing steps to assure optimum utilization of equipment and personnel. Long range planning aided the move.

Maximum Flow–Top Quality Brass Barbed HOSE FITTINGS *That Reduce Costs 3 Ways!*

1. Lower unit cost
2. Lower installation cost
3. Eliminates reducing bushings



These fittings are available in various combinations of hose stem outlets to pipe sizes. This eliminates the necessity of using reducing bushings. Fittings are: made from non-porous brass bar stock—*wide aperatures give maximum flow of air and water.*

Available in solid one piece fittings or 3 piece J. I. C. union adapter type fittings. Write today for our full line catalog.

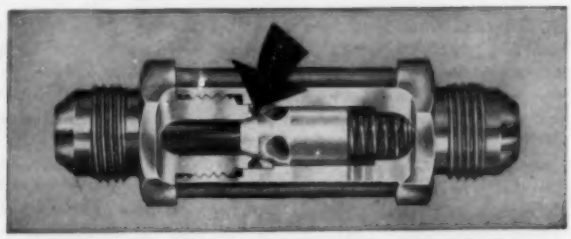
Jobber and agent inquiries invited

Service Mfg. & Supply Co.

315 East State Fair Detroit 3, Mich. TWinbrook 3-6565

Simple, Secure . . . Leak-Tight!

The FLEXIBLE SEAL SEAT*



Responsive action of the soft O-ring seal provides absolute leak-tightness. Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts; no extra end seals. Stocked in 6 standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Write for data sheet.

KEPNER PRODUCTS COMPANY

7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC

CHECK VALVES

* PATENT APPLIED FOR

Circle 121 on Reader Service Card

Circle 79 on Reader Service Card

William C. Denison was named as a vice president of **American Brake Shoe Co.**, and

William C. Denison
Denison Engineering Div.
American Brake Shoe Co.

appointed to the operations policy committee. He is also president of their Denison Engineering Division.

Sidney W. Nelson has been named a sales representative in the Cincinnati district office of **Clark Controller Co.**, Cleveland.

Continued on next page

Circle 11 on Reader Service Card

SEND your specifications for hydraulic cylinders to American, specialists in hollow boring and honing. We manufacture from tubing or forgings in carbon or alloy steels up to 15" I.D. Over 40 years experience backed by precision machines and skilled craftsmen will save you time and money. Send your blueprints.

Telephone
ERIE
2-3664

AMERICAN HOLLOW BORING COMPANY
1954 RASPBERRY STREET • ERIE, PA.

SPECIALISTS IN THE MANUFACTURE OF **HYDRAULIC CYLINDERS**

PNEUMATICS SHEFFER HYDRAULICS

1 1/8" Bore Hydraulic Clamp Type Cylinder

CLH Series

1 200 PSI AIR—Up to 2000 PSI Hydraulic
2 Double acting or Spring Return
3 Heads Machined from 1⅛" Square Bar Stock
4 Hard Chrome Plated Piston Rod
5 Universal or Pivot Mount
6 Stocked in one, two & three inch stroke

Write For Bulletin #756

THE SHEFFER CORP.
CINCINNATI 15, OHIO
MOST COMPLETE LINE OF CYLINDERS IN THE INDUSTRY
SOME TERRITORIES OPEN

Circle 122 on Reader Service Card

Modernair

NEW ¼" SOLENOID VALVE

for Air or Oil Hydraulic Service, 30 to 150 p.s.i.

★ ULTRA COMPACT...only 4-9/16" long, 3-5/16" high, 1-3/4" wide overall!
★ NON-CORROSIVE CONSTRUCTION... brass and aluminum throughout.
★ "O" RING SEALS... replaceable without disturbing piping.
★ AVAILABLE IN SINGLE OR DOUBLE SOLENOID for all popular a.c. or d.c. voltages.
★ 3-WAY (3 port) OR 4-Way (5-port) MODELS, with or without exhaust speed control valves as shown. Standard ports are female 1/4" NPT.

MODERNAIR's new BV Series ¼" solenoids put the answer to scores of fluid power control problems literally in the palm of your hand. Why not get the facts now? Write or wire for specifications, prices.

Modernair CORPORATION
Trademark
Dept. B-11 400 PREDA ST., SAN LEANDRO, CALIF.
Member National Fluid Power Association 20

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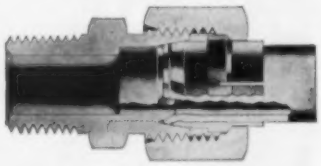
Circle 47 on Reader Service Card

FLODAR *Self-flaring* FITTINGS

- ELIMINATE PRE-FLARING
- CUT INSTALLATION COSTS

Tightening the nut automatically flares tubing. Wedge insert supports tubing inner wall and makes perfect joint. Spring steel sleeve has collet type fingers that tightly grip tube—absorb shock and vibration. Permits repeated assembly and disassembly.

Automatically flares all metal tubing 1/8 to 2" O.D.



Write for
NEW CATALOGS
showing Hydraulic Tube, Straight Thread O-Ring and Pipe Fittings.

FLODAR CORPORATION
16911 ST. CLAIR AVE. CLEVELAND 10, OHIO

POSITIVE Seal for Oil

By Using **AUTO-DIESEL**

2 or 3 Piece Hydraulic Seal Rings

This ring is especially effective for sealing oil. There are NO GAPS and it will take high pressure. Auto-Diesel 2 or 3 Piece Compression Rings are made for high pressure service in air, steam and hydraulic cylinders. They retard wear and also give superior sealing action. They give more positive sealing than a one piece ring. Can be made of cast iron, steel, bronze or aluminum. Made in sizes up to 35". It will pay to investigate.

Write for Details

THE AUTO-DIESEL PISTON RING CO.
3137 Superior Avenue • Cleveland 14, Ohio
"RINGS and SHAPES Since 1921"

Chicago Rep.—Vince Holstrom Phone RO 1-2029
Detroit Rep.—Clifford-Rockwell Co. Phone DI 1-8873
Eastern Rep.—A. C. Wilkins Philadelphia MU 8-7568

Post Scripts of Industry continued

Charles C. Neighbors, Jr. has joined **Greer Hydraulics, Inc.** as coordinator of advertising and public relations.

Fornaciari Co., Los Angeles, appointed **Malcolm F. Cliff** as manager of their hydraulic division.

Malcolm F. Cliff
Fornaciari Co.

Richard W. Holmes was promoted to sales manager of the eastern division, north, at **E. F. Houghton & Co.**, with headquarters in Worcester, Mass. **Lewis R. Tharp** was made assistant manager of the Detroit sales division.

Richard W. Holmes
E. F. Houghton Co.

Atlas Valve Co., Newark N. J., named **Robert H. White** sales representative for northern New Jersey.

Continued on page 184

Circle 135 on Reader Service Card

Send for this
FREE BROCHURE
showing how

CROWN
HYDRA-TROL
Remote Control

- Has positive stroke in both directions.
- Does not depend on spring return or outside power sources.
- Immediate synchronization of system in either direction.
- Is a self-contained hydraulic system for positive positioning of remotely-located levers, shafts, and other equipment.
- Valuable in controlling hydraulic valves, winches, throttles, slitting machines, butterfly valves, etc.

Write for bulletin A

Crown Control Division

of

TRIMOUNT INSTRUMENT COMPANY
3119 WEST LAKE STREET • CHICAGO 12, ILLINOIS

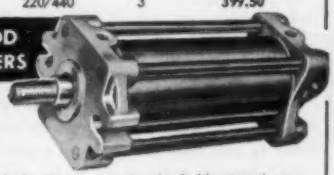
When the design calls for an indicating gauge, specify the best-
MARSH
New catalog covers gauges for every need
MARSH INSTRUMENT CO.
Sales Affiliate of Jas. P. Marsh Corporation
Dept. 19, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd
8407 103rd Street, Edmonton, Alberta
Export Dept.,
3501 Howard Street, Skokie, Ill.

NEW! PALLEY SPECIAL
SAVE on
ELECTRIC HYDRAULIC PUMP MOTORS
1 and 3 Phase, 60 Cycle AC
220/440V, 115/230V.
3/4 to 15 HORSEPOWER
AS LOW AS 99.50

Specially designed by the Palley Engineering staff with the cooperation of a leading manufacturer of Electric Motors. These Pump Motors are built to our own exacting specs and designed to couple directly to all types of aircraft hydraulic pumps. Built to continuous duty with high starting torque and are drip-proof. See examples listed below. Many others in stock! Send for Catalog.

Part No.	H.P.	R.P.M.	Voltage	Phase	Price each
H-SM1	3/4	1800	115/230	1	$ 99.50
H-SM2	1	1800	115/230	1	127.50
H-SM5	2	3600	220/440	3	149.50
H-SM13	10	3600	220/440	3	319.50
H-SM15	15	3600	220/440	3	399.50

Special Palley TIE ROD OIL or AIR CYLINDERS



150 PSI AIR or 750 PSI OIL on 2", 3", 4" & 5" BORES

150 PSI AIR or 500 PSI OIL on 6" & 8" BORES

Built to our own exacting standards. Rigid, rugged and reliable tie-rod construction. Hard-chromed piston rods. Built-in durability that keeps them working day after day with a minimum of "down" time. Dual mounting. Pivot base. Flanged head. Superb quality at typical Palley Savings. See examples below.

Part No.	Bore	Stroke	Thrust at 150 PSI (Air)	Thrust at 750 PSI (Oil)	Price
200-4	2"	4"	470 lbs.	2350 lbs.	$27.50
200-16	2"	16"	470 lbs.	2350 lbs.	36.90
300-6	3"	6"	1060 lbs.	5300 lbs.	34.50
300-36	3"	36"	1060 lbs.	5300 lbs.	59.05
400-12	4"	12"	1885 lbs.	9425 lbs.	49.50
500-4	5"	4"	2950 lbs.	14,725 lbs.	69.90
600-8	6"	8"	4250 lbs.	14,150 lbs.	116.85
800-12	8"	12"	7540 lbs.	25,100 lbs.	190.30

SPECIAL GOVERNMENT SURPLUS BARGAINS

2000 PSI HYD. CYLINDER

Genuine top quality Gov't Surplus. Used but excellent condition. Has a Bore of 2-1/4", Shaft 1", Stroke 4". Eye-to-eye lgth. 13½". Ports 1/4" AN.

SPECIAL Only 12.75

STRATO-POWER HYD. PUMP

Positive displacement, piston type pump. Has a built-in variable flow control valve. Capacity is 2.4 GPM at 1800 RPM. Maximum cont. operating pressure 1400 PSI. Max. operating speed 3750 RPM. Rotates in either direction. Has 1" internal pipe ports. **27.50**

VICKERS HYD. ANGLE PUMPS

Made to top aircraft specs. Will fit pump motors above.

Cat. No.	GPM	PSI	RPM	Price
H-P4A	5.3	1000	3000	$22.50*
H-P5A	2.7	1500	3000	25.75*
H-P4U	6	1000	3000	22.50*

*Used but excellent condition.

WORLD'S MOST AMAZING BARGAIN CATALOG

ORDER YOURS TODAY **1957 EDITION - 396 PAGES**

NATIONALLY ADVERTISED MERCHANDISE • NEW and USED GOV'T. SURPLUS • FACTORY CLOSEOUTS • EXCITING IMPORTS!

This catalog features the LARGEST STOCK of HYDRAULIC EQUIPMENT & SUPPLIES ever seen under one roof! Brand New, ON-THE-SHELF stock of specially designed, Industrial Cylinders, manufactured to our own specifications! Also a tremendous selection of Gov't Surplus Cylinders, Valves, Pumps, Motors, Tubing, Hardware, Plumbing, etc. The Greatest Stock we've ever had at the Lowest Prices in our history. Also complete stocks of Electric Motors, Power Tools, Plant and Office Furniture, Optical Insts., Test Equipment plus Industrial Tools of all types.

ORDER FROM THIS AD — Pay by Money Order or Check. 1/2 deposit with C.O.D.s. Purchase orders accepted from well rated D&B firms. All prices are F.O.B. our warehouse in Los Angeles, California.

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Los Angeles 58, California

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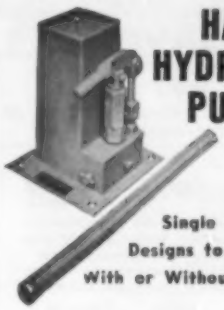

HAND HYDRAULIC PUMPS

Single and Double Designs to 20,000 PSI With or Without Reservoir

160 Cubic Inch Reservoir with 8" x 8" Base Plate. Optional Size Piston: ⅜", ½", ¾", 1".

Handle length: 18 inches
Catalog No. 160

We specialize in hand pump units to operate in temperatures from minus 65F to plus 160F and with any capacity reservoirs required.

The single pump with ½" or ¾" piston now available in stainless steel.

WILLIAM S. PINE
Hydraulic Hand Pumps for 1001 Uses
1635 E. 22nd St., Los Angeles 11, Calif.

Post Scripts of Industry
continued

Petch Mfg. Co., Alpena, Mich., have moved into an enlarged and modern plant. Complete facilities are now under one roof promoting new efficiencies in manufacturing. Total plant floor space is 30,000 sq. ft., with 2200 sq ft being occupied by general office personnel and engineering. National sales office is still at 463 York St., Detroit, to facilitate travel and communication. Shown is **Charles L. Petch,** president, with **W. Hutcherson,** general sales manager at right.

NEW!

Atkomatic
stainless steel
SOLENOID VALVE

controls high pressures!
resists corrosion!

- **Rated to 6000 psi**
- **Explosion-proof housing optional**
- **Pipe sizes ⅛, ¼, ⅜, ½"**
- **Bubble-tight**

Atkomatic's new stainless steel barstock, 2-way solenoid valve gives you instant, dependable control of high pressure corrosive and explosive gases and fluids. Direct-lift, angle-type construction operates from 500° to minus 200° F.
Write for details today!

ATKOMATIC VALVE COMPANY, INC.
Dept. 6A—545 W. Abbott St. • Indianapolis, Indiana

specify standard

UNBRAKO

Dryseal-Thread Pressure Plugs

Use them in place of ordinary pipe plugs, or wherever liquids and gases must be contained under pressure. UNBRAKOs seal without compound. They are made of the same high strength alloy steels, have fully formed threads and the same internal wrenching feature as other UNBRAKO socket screws. Standard sizes—1/16" to 1¼"—are stocked by authorized industrial distributors. Ask your UNBRAKO supplier for Bulletin 883. Or write STANDARD PRESSED STEEL CO., Jenkintown 2, Pa.

STANDARD PRESSED STEEL CO.
UNBRAKO SOCKET SCREW DIVISION **SPS**
JENKINTOWN PENNSYLVANIA

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Circle 128 on Reader Service Card

Racine Hydraulics & Machinery, Inc., Racine, Wis., recently held a new product preview during which introduction of electronic controls to their pump line was announced. Sales representatives whose company associations with Racine range from 16 to 25 years were presented with testimonial placques by President **M. E. Erskine** (center) at the firm's recent Technical Engineering Conference for U. S., Canadian, and British representatives. Left to right standing in rear are **Robert G. Pearse** of **G. M. Pearse & Co.,** Newark, N. J., 22 years company association; **S. G. (Bill) Morris** of **S. G. Morris Co.,** Cleveland, 24 years; **J. M. Grimstad** of **J. M. Grimstad Co.,** Milwaukee, 25 years; **Richard P. Rankin** of **Walter A. Rankin Co.,** Philadelphia, 18 years; **Ralph W. Atkinson** of **Ralph W. Atkinson Co.,** Los Angeles, 16 years; and **John F. Weldon, Weldon Engineering Co.,** Chicago, 16 years.

Parker Appliance Co., Cleveland, announced the following distributors: **Brake Supply Co., Inc.,** 700 Sycamore St., Evansville, Ind., **James E. Adams,** president; **Industrial Hydraulics Co.,** 5405 W. Vliet St., Milwaukee, Wis., **Harry R. Holsen; Whitehead Metal Products Co.,** 2128 Elmwood Ave., Buffalo, and 207 W. Taylor St., Syracuse, N.Y.; **Meier Brass & Aluminum Co.,** 1471 E. Nine-Mile Rd., Hazel Park (Detroit), Mich., **Robert J. Meier,** president.

Robert A. Lux has assumed duties as sales engineer for the New England states for the **Fort Wayne Div., Weatherhead Co.**

Anker-Holth Div., Port Huron, Mich., announced the following exclusive sales representatives: **Components & Equipment Co., Inc.,** 501 Clark Ave., St. Louis 19, Mo., **Robert S. Guignon; Garber Engineering**

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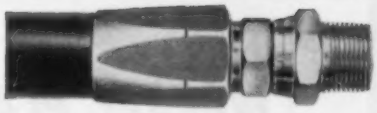
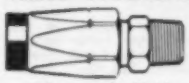
LEAK-PROOF!

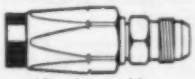
REQUIRE NO SPECIAL ASSEMBLY TOOLS



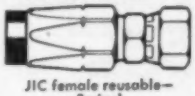
NEW HYDRALINK MALE SWIVEL REUSABLE COUPLING



Male reusable—Rigid



JIC male reusable



JIC female reusable—Swivel

90° Swivel elbow

Permanent coupling assemblies

Hydralink couplings, both permanent and reusable types, are quality units conforming design-wise with national and JIC standards but going a step farther in providing simplified installation and positive leak-proof seals that exceed the demands of peak pressure loads. The new Hydralink catalog is easy to read and helps you select the units you want without cross reference and guessing. Write for it today. **Distributor and Agent territories still available.**

HYDRALINK CORPORATION

1009 E. 10 Mile Rd.
Hazel Park, Mich.

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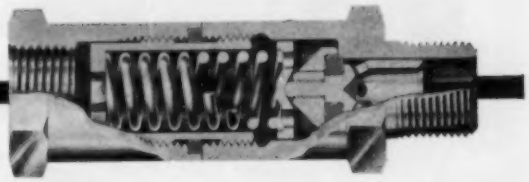
This

RELIEF VALVE

Seals Tight



Seals Tight To over 95% of cracking pressure provided by Circle Seal's "O" Ring sealing principle.

Relieves Accurately Opens consistently at preset cracking pressure.

Flows Freely Minimum flow restriction due to streamlined poppet and full flow ports.

Reseats Tight Zero leakage within 10% of cracking pressure.

Circle Seal Representatives throughout the United States

Circle Seal Products Co.
Incorporated
2181 EAST FOOTHILL BOULEVARD
PASADENA, CALIFORNIA

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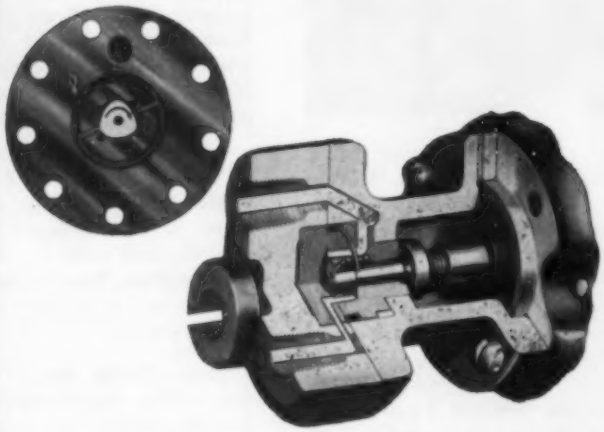
WELDON

FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



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C. B. Hunt & Son, Inc., Salem, Ohio, appointed **Kenneth R. Meyer** director of engineering.

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Walter Kakin has joined American Cast Iron Pipe Co., Birmingham, Ala., as consultant and sales agent for the special products division.

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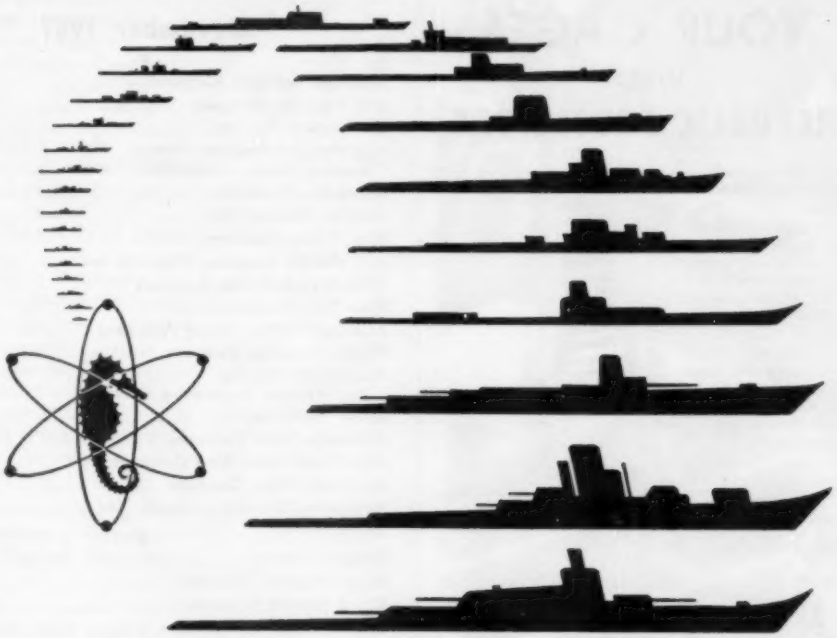

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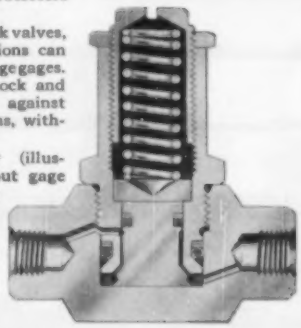

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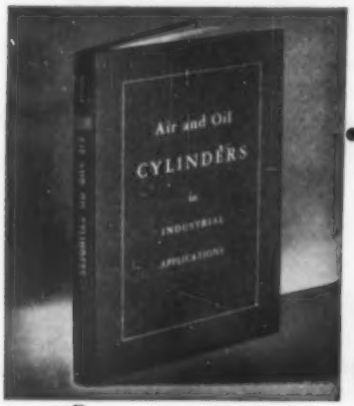

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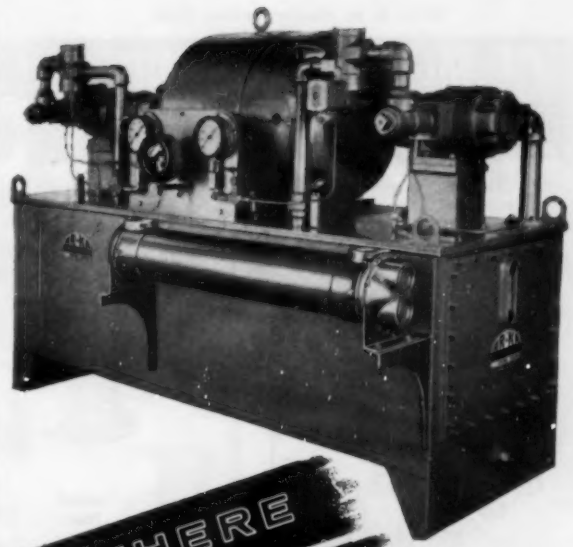

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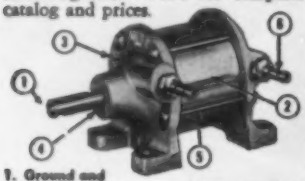

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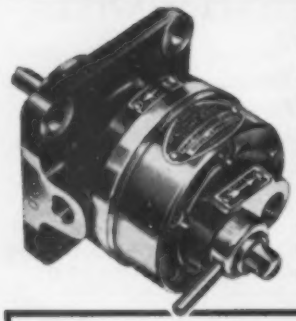

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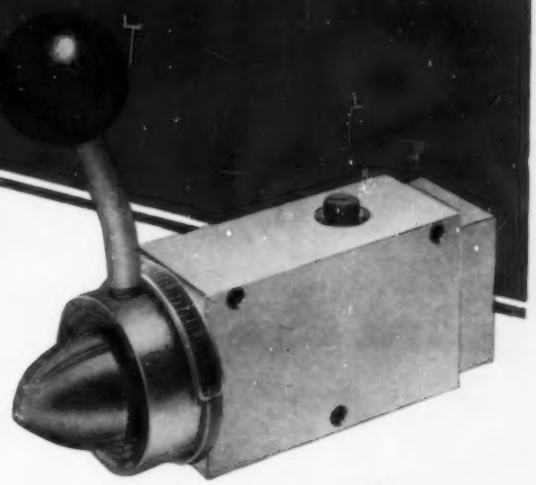

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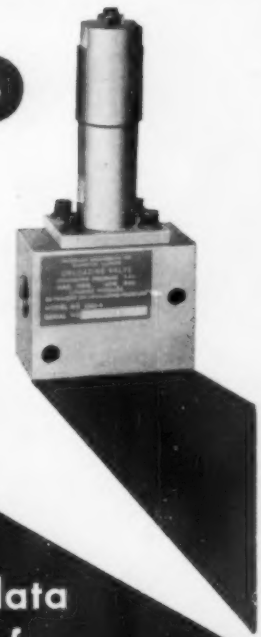

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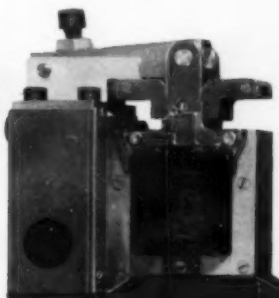

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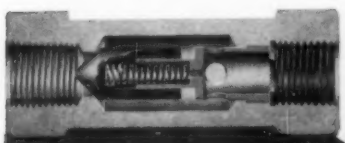

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